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Arkansas State Health Alliance for Records Exchange (SHARE)

Response to Arkansas Health Information Exchange RFI

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EXECUTIVE SUMMARY

Thomson Reuters is pleased to respond to the Arkansas State Health Alliance for Records Exchange (SHARE) Request for Information (RFI) for a Health Information Exchange (HIE) solution. Our approach is supported by select partners who play a vital role in the unique solution we are proposing:

CareEvolution— CareEvolution, our HIE partner, currently provides the HIE backbone for the South Carolina Health Information Exchange ("SCHIEx"), which covers a 10-year health history of more than six million citizens of the state inferred from Medicaid and UB92/HCFA1500 claims, and is available for use by more than 4,000 care providers across South Carolina.

CIBER--- CIBER is a leading international system integration consultancy, with 35 years of experience supporting government and commercial sectors. Based in Greenwood Village, Colorado, the company's consultants serve client businesses from over 40 US offices, 25 European offices, and seven offices in Asia/Pacific. Operating in 18 countries, CIBER has more than 8500 employees and annual revenue of $1.1 billion.

Molina Medicaid Solution--- Molina Medicaid Solutions, a subsidiary of Molina Health Care, Inc., (previously the Health Information Management Division of Unisys Corporation) has fiscal agent contracts in Maine, Idaho, West Virginia, Louisiana and New Jersey. Molina Medicaid Solutions is a recognized leader in supporting large-scale data processing requirements. Since entering the Medicaid market, Molina has performed 18 successful implementations and consistently delivered in accordance with its contractual obligations. Molina Medicaid Solutions is positioned to support the Arkansas SHARE requirement to provide a flexible, agile solution to support the Arkansas' program and information management objectives. The guiding principles set forth by SHARE in achieving a statewide backbone for statewide health information exchange resonate strongly with strategic initiatives launched by our organization to address ARRA Stimulus Incentives that span federal, state and provider stakeholders.

Thomson Reuters looks forward to learning more about SHARE's initiative and strategies; however, for the purposes of responding to this RFI, we and our partners are prepared to assist SHARE in considering the potential benefits of two different strategic implementation options for Arkansas' statewide HIE:

1. The current RFI assumes a stand-alone HIE implementation, which the bulk of this RFI directly addresses. A stand alone implementation can allow the state to isolate the solution and give the implementation time to verify alignment with a variety of key stakeholders throughout the state.

2. There is also potential for SHARE to consider an implementation of an integrated MMIS and HIE system that leverages two significant state initiatives— Medicaid Management Information System (MMIS) and HIE. Given that Medicaid will need to meet the same requirements for an HIE as the state designated entity and given that Medicaid has a sustainable funding stream, we believe it is a viable option to designate Medicaid as a partner to build and maintain the State's HIE. The requirements for the state HIE can be

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included in the request for proposals for the procurement of a new MMIS. Furthermore, the same implementation timeline can be shared or an accelerated timeline can be considered with a launch prior to the MMIS launch, thereby achieving eligibility for a 90% Federal match in funding for infrastructure. By including an HIE component in the MMIS procurement process, the existing MMIS infrastructure and contract oversight can be leveraged thereby reducing the overall costs associated with implementing HIE requirements as well as providing a sustainability model over time.

We welcome the opportunity to further discuss these options with the State as appropriate. Regardless of which of the above options the state selects, we are confident Thomson Reuter's HIE Advantage is the optimal partner for Arkansas' HIE for the following reasons:

1. Scalability

Arkansas needs a HIE solution that will be able to accommodate every citizen in the state, providing longitudinal information as citizens move through the continuum of health. The scalability of our HIE solution is unsurpassed as evidenced by four years of production operation in the state of South Carolina.

2. Standards Integration

Most HIE solutions support the major clinical standards; but the true test of an effective HIE solution is its ability to integrate diverse standards in a way that minimizes confusion and overlap. Our HIE solution contains proven methodologies and tools that translate and clarify diverse medical coding standards.

Our HIE Advantage solution includes terminology services that are used to tie together technology, nomenclature, data-element or coding transactions standards across disparate systems, such as HIPAA-standard transaction sets, including HL7 and ANSI, LOINC, SNOMED CT, RxNorm, ICD, NCPDP, HCPCS, CPT, and other document terminology.

A significant challenge in state/nationwide health information exchange will be ensuring adherence to national terminology standards. The majority of today's healthcare organizations use non-standard terminology. NMHIC and others participating in the NHIN Trial Implementations Project are required to accumulate non-standard data across a community and translate and consolidate that into data that meets national standards. As we progress, NMHIC is expected to facilitate translation at the various source systems across the state.

3. Flexibility for the future

No American industry is changing more than the healthcare industry. Changes being made on a national scale, such as ICD 10/5010 coding upgrades, Health Care Reform legislation, ARRA meaningful use requirements, new HIPAA security and privacy regulations, and new Medicaid and Medicare program regulations are shifting the landscape of this industry almost daily. For flexibility, it is essential that Arkansas select an HIE solution that is designed from the ground up. That is what our solution offers.

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Concerning existing HL7 message traffic, WAN/network standards, security policies, or reporting requirements, HIE technology should not force change. Policy, privacy, security, governance, compliance, and clinical value should drive the IT agenda, not the requirements of technology vendors. This means a greater emphasis on the ability to iterate. Given that most HIEs operate within nascent organizational constructs, an HIE technology platform must support a highly incremental approach, and not require disruptive change. This also means the HIE solution must also be able to allow à la carte adoption.

We believe a holistic platform covering the gamut of technology components needed for effective HIE deployment is necessary; however, we understand that different participants in a given HIE may have divergent needs. Not all participants need all or the same technology components to participate. Therefore, the technology platform must be available piecemeal on an as needed basis.

In 2008, we were a “Leader” implementer at the HIMSS Interoperability Showcase where we demonstrated HIEBus (a key component of Thomson Reuter’s HIE Advantage) participating in standards compliant exchange with nearly 70 other healthcare IT vendors. One of only 14 organizations in the “Leader” category, HIEBus tools were reviewed by Senator Frist, Dr. Kolodner, and several international VIP tours. At a technical level, we are fully engaged with IHE (Integrating the Healthcare Enterprise). In the 2008 Chicago based “Connectathon” we completed testing for key IHE profiles. In 2008, we successfully tested Exchange of Personal Health Record Content (XPHR) consumer and creator, Cross-Enterprise Clinical Documents Share (xds.b) document consumer, Patient Demographics Query (PDQ) patient demographics consumer, and Patient Identifier Cross-referencing for MPI patient identity consumer. Advantage HIE recently completed IHE (Integrating the Healthcare Enterprise) compliance testing for 2010 for the key patient identity, document exchange, and security/audit profiles

We are now working in Central Indiana to link our client Community Health Network using the NHIN II Gateway to the Indiana Health Information Exchange. Specifically, we are working with the Indiana Health Information Exchange for a production implementation of IHE PIX and XDS to result in a CCD based exchange with the Indiana Health Information Exchange to/from the Community Health Network, a 70-site IDN in Indiana.

Finally, we seek collaboration with the DOD to complete a NHIN II compliant gateway from SCHIEx to the DOD for the military personnel stationed in South Carolina.

4. Security and privacy

The fastest way to discourage use and confidence in a statewide HIE solution is for a major security breach to occur. Having been in production for over four years on a statewide basis, we have firsthand knowledge of real world security and privacy threats. Maximum security and privacy is a critical part of our HIE solution, which is why CIBER Inc. is part of our solution team. CIBER has extensive experience in security assessment and management having performed security assessments for the IRS, the FBI, NASA, the Department of the Treasury, and many state governments.

Securing Data in Motion

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Any information passed or communicated over the "network" is considered data in motion. There are two ways to secure such transmissions which may be used—message layer security and transport layer security (TLS). One may choose to encrypt the content of the message prior to sending the message. Alternatively, one could secure the actual "channel" or transport itself (such as VPN or SSL encryption within Web browsers or Web services). HIE Advantage **always** ensures message level security so that all "contents" are encrypted prior to sending "over-the-wire." In this event, even if a particular implementation fails to have a secure transport, the message is considered secure per federal standards. Additionally, the specific client deployment may wish to implement TLS (such as VPN or SSL), in which case double encryption would be effected. Not only would the content itself be encrypted but so would the transport. The specific encryption CIPHER used is FIPS 140-2 recommended AES (advanced encryption standard).

Note regarding "Double Encryption" —there is no federal requirement for double encryption.

HIE Advantage secure communication infrastructure is built on X.509 Public Key Infrastructure and provides:

- Identity verification of both the sending and receiving entities
- Message encryption to ensure data confidentiality
- Message signing verifying data origin
- Protection against malformed or malicious messages

HIE Advantage will use the public Internet to transmit demographic data from an Adapter (provider or source site) to the HIE application. Data security during transmission can be provided at two levels. First, HIE Advantage implements the WS-Security framework to encrypt the message body of all Web service traffic. Second, these web service calls can be transported using secure HTTP in order to meet the double encryption requirement requested for the HIE project.

Securing Data at Rest

While physical data center and operating system and application software level safeguards exist to prevent unauthorized access to PHI information managed by the computing assets in the exchange, HIE Advantage goes further by encrypting critical PHI within the disk. In other words, even the database administrator does not have clear text access to sensitive PHI information within HIE Advantage; this is because "columns" such as Social Security Numbers are encrypted. By securing data at-rest, we ensure that the system is resilient against inadvertent disclosures from stolen laptops, backup tapes, and the like.

Additionally, the underlying component, CryptoRLS™ (the HIE Advantage Record Locator Service), implements a highly advanced FIPS compliant NSA (National Security Agency) promulgated hashing standard to ensure that no PHI exists within the record locator service. CryptoRLS™ implements an advanced, industry-leading approach to cryptographically hash all sensitive information that is stored in the centralized, statewide resource that is used for record location. The exceptionally high level of security implemented by using CryptoRLS™ on this extremely sensitive data store provides a key point of differentiation for our proposal, as other commercially available solutions do not hash their record locator store. All data that is managed within the HIE Advantage

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RLS is persisted using a secure, one-way crypto-hash format. Using this transformation and persistence scheme, the HIE Advantage RLS provides the ultimate level of data security. By storing data in this format, the demographic information is secure against nearly any form of unauthorized disclosure, as the original clear text names and identifiers are unrecoverable. Record linking is performed by comparing records using the hashed identifiers.

CryptoRLS™ is currently the only commercially available solution to provide this exceptional level of data protection for this critical and highly sensitive statewide resource. Patient data that is passed through a HIE Advantage adapter via the Clinical Data Interface Service (via Secure Channel 1 as described above) can also be transmitted to other adapters in the HIE Advantage network. This exchange of clinical data will occur only if clinical care is being provided by the facilities being served by each adapter. This exchange of clinical data constitutes the core functionality of the HIE Advantage platform.

Privacy policies can be set on a per-patient record basis and can restrict any information from being transmitted to another adapter. These policies can restrict records that may include sensitive information (i.e., mental health) from being sent to a specific adapter, or to any adapter in the HIE Advantage network.

5. Longitudinal Data for Clinical Decision Support

The ultimate test of a robust HIE is not just sharing electronic health data, but sharing electronic health data in a context and format that is useful and meaningful for helping healthcare providers make the right decisions at the point of patient care.

Our HIE Advantage Continuity of Care Viewer provides a real time summary of patient data from across many sources of care, for use by their clinicians and other authorized care givers, to facilitate and improve real-time clinical decision making. The summarization of longitudinal, clinical data can be daunting, especially for patients with co-morbidities or complex chronic conditions. By applying Thomson Reuters Medical Episode Grouping methodologies, complex, longitudinal patient data can be grouped and condensed into more actionable and meaningful data displays.

Additionally, advanced Micromedex drug-to-drug alerts and reference data are embedded to provide real-time access to best practice information that reduces safety errors and increases quality outcomes. Micromedex saves clinicians valuable time and helps them ensure their patients' needs are taken care of promptly and safely by providing answers to the most complex clinical questions related to DrugDex/DrugPoints, drug interactions, IV screening, drug comparison, drug ID, DiseaseDex/ClinicalPoints/Clinical Checklist, patient education, and laboratory test information.

HIE Advantage is able to generate a NHIN/HITSP compliant Continuity of Care Document (CCD) aggregating data from all disparate sources. For those providers not yet ready to accommodate CCD within their existing edge applications, we offer Web based longitudinal history viewers that can be embedded within the EMR/PMIS/HIS, resulting in a "community health record" unified view. This investment in advanced human factors engineering recognizes the fact that most traditional EMRs are not designed to effectively deliver longitudinal information—they are designed to capture and display episode of care based information.

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6. Experience

As the prime, Thomson Reuters brings extensive experience, capabilities, and best practices in assembling large scale solutions across the healthcare continuum. This experience includes numerous installations of HIE technology to support disease surveillance, public health reporting, and clinical decision support. In North Carolina, we installed the nation's largest HIE for surveillance of emergency department experience that gathers real time data via secure methods from 112 hospitals.

At the Federal level, we currently work with the Centers for Medicare & Medicaid Services (CMS) to assemble the nation's largest repository of Medicaid claims data, providing consultation on NHIN standards, and developing methodologies to monitor and measure meaningful use.

At the state level, we currently assist 26 Medicaid agencies with a wide range of needs, including responding to the HITECH Act for Medicaid HIE, extensive fraud and abuse investigation, and targeting and implementing information-driven strategies for chronic disease management, medical home research, improvement of child and family health, and numerous initiatives focused on long-term care and treatment of the elderly population.

In the provider community, we have over 3,000 client contracts covering decision support in the clinical, operational, and marketing functions of hospitals and integrated delivery networks. Additionally, we also serve as one of the nation's largest providers of state data services, including the collection, cleansing, and submission of UB04 reporting requirements, as well as the creation and distribution of a wide variety of quality and compliance reporting applications. Within the hospital environment, Thomson Reuters Clinical Xpert Navigator platform—a comprehensive suite of clinical decision support tools—is currently installed in 118 customers, representing 251 hospitals in 31 states.

Finally, we are the nation's largest provider of health information tools for all payer organizations, including more than 300 installations of Fortune 500 employers and over 100 health plans. This span of information services across the spectrum of healthcare uniquely positions Thomson Reuters to understand and shape HIE functionality on a statewide basis, and to serve as a partner for SHARE in working through important requirements for technical scalability, information management, and provider adoption over time.

Thomson Reuters has selected CIBER as its systems integration partner for this opportunity. CIBER is an ideal partner for the Arkansas HIE project because of its extensive experience and credentials in:

- Systems integration
- State government IT
- Healthcare IT

More than 3,000 customers—including mid-market leaders, state agencies, and many of the Fortune 500—rely on CIBER's expertise to leverage their investment in technology and guide them into the global digital economy. In 2008, CIBER was ranked #1 and #6 in world, respectively, by

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Customer Experience Survey for Mid-Tier and Tier 1 Infrastructure Outsourcing Vendors by the Black Book of Outsourcing. CIBER's management approach is based on the CIBER Project Management Methodology (CPMM), and adheres to ITIL v3 and CMMI-DEV Level 2 processes. CIBER is SEI appraised at a CMMI-DEV Level 3 capability for Project Planning, Project Monitoring and Control, Measurement and Analysis, Requirements Management, Configuration Management, Supplier Agreement Management, and Process and Product Quality Assurance. In a 2008 customer satisfaction survey, 96 percent of clients said they would unequivocally use CIBER again and 97 percent would unequivocally recommend CIBER to a colleague. CIBER has won numerous awards ranging from technical excellence to superior workplace flexibility

CIBER's State Government Solutions (SGS) is a leading provider of information technology (IT) professional services and solutions to the state government marketplace. CIBER's State Government experience includes work with all 50 state governments and over 600 state and local government agencies. Currently, CIBER has over 2,000 consultants serving in public sector engagements across the country. CIBER is an active member and sponsor of the National Association of State Chief Information Officers (NASCIO). CIBER serves on the Corporate Leadership Council and the Digital Government Committee. The National Electronic Commerce Coordinating Committee (NECCC) has provided a forum for addressing e-Government technical and non-technical issues. CIBER was a contributing member of a work group whose goal was to provide a template to assist Government in assessing "e-government Readiness."

REQUESTED INFORMATION

5.1 Mandatory Response Requirements

1. Name and Category of Respondent

a. Company Name	**Thomson Reuters (Healthcare) Inc.**
b. Category of Respondent	Solution Provider
c. Address	777 E. Eisenhower Parkway, Ann Arbor, MI 48108

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2. Name of Vendor Representative responsible for any future business opportunity with the State of Arkansas.

d. Contact name	Larry Yuhasz
e. Contact title	Director, Strategy and Business Development
f. Address	777 E. Eisenhower Parkway, Ann Arbor, MI 48108
g. Contact telephone number	734-913-3192
h. Contact email address	Larry.yuhasz@thomsonreuters.com

Thomson Reuters, with our partners CareEvolution, CIBER, and Molina Medicaid Solutions can offer SHARE unique insight and working knowledge into the best practices for successfully designing, launching and deploying a statewide HIE through a carefully phased implementation---one that optimizes the potential for provider adoption, improved clinical outcomes, reduced costs, and sustainability through annual subscriptions to valued applications and reporting services.

- Through Thomson Reuters, we have over 6 years experience running the nation's largest HIE-based, emergency room surveillance system in North Carolina.
- Through CareEvolution, we have the nation's largest HIE-based care coordination platform in South Carolina. This advanced installation has direct applicability to SHARE's mission and vision in that South Carolina's healthcare infrastructure is also geographically dispersed with high numbers of rural providers and similar profiles of disease prevalence and care coordination challenges across the state.
- Through CIBER, we have practical and cost effective insight into developing a scalable hosting environment, while also dovetailing HIE interface deployment as adoption rates increase over time through 2015.
- Through Molina Medicaid Solutions, we are positioned to respond to a combined MMIS/HIE implementation option.

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3. Summary Description of Solution

In 2007, Thomson Reuters engaged a Health Information Exchange (HIE) vendor named CareEvolution, Inc. With corporate headquarters based in Michigan, CareEvolution had developed the nation's first commercial off-the-shelf (COTS) HIE platform that was interoperable, secure, scalable, and flexible enough to enable both federated and centralized installations (e.g. a hybrid). The CareEvolution HIE platform aligned nicely with our extensive Decision Support Solutions that help organizations across the healthcare industry improve clinical and business performance. By combining the CareEvolution HIE platform with our multi-market decision support solutions, we created the foundation for a statewide solution that could capture real-time clinical and administrative data, empower providers with a continuity of care viewer, and provide advanced decision support to all healthcare stakeholders through a centralized performance reporting application.

The fusion of CareEvolution's technology and our capabilities has become **Thomson Reuters HIE Advantage.** The underpinnings of our HIE Advantage technology became the backbone of South Carolina's Health Information Exchange (SCHIEx). The SCHIEx embodies the type of HIE platform that CMS is stimulating through NHIN, HITECH, ARRA and other incentive programs. Unlike other more local or private HIEs, SCHIEx is unique in its ability to provide an HIE ecosystem for those providers who already have EHR technology and the more than 80% of providers who currently do not have any EMR. An innovative Web-based "thin-EMR" enables all providers to participate in the exchange regardless of their current HIT status.

Additionally, SCHIEx can cost-effectively mobilize HIE adapters to enable quick "on ramps" to the SCHIEx "highway." Using this proven technology, we are connecting our extensive Medicaid and Medicare claims repositories to SCHIEx. The result is an HIE backbone that contains both clinical data feeds from around the state, in addition to claims data from Medicaid and UB92 data from hospitals across the state. This enables SCHIEx to link administrative and clinical data, and create meaningful use and other quality measures that can be distributed to providers throughout the state.

In North Carolina, where we created and deployed the nation's largest state-wide emergency room surveillance system, the North Carolina Healthcare Surveillance System (NCHESS), we have deployed emergency room and ambulatory data feeds from across the state to establish a statewide HIE backbone using our HIE Advantage. The intent of this innovation is to develop meaningful use proof cases at early adopter pilot hospitals in the State prior to enabling a more state wide implementation.

At Community Health Network in Indiana, we have embedded our advanced Medical Episode Grouper (MEG) methodology and reference data within our native web based Continuity of Care Viewer. The benefit of this synergy is to enable clinicians, at the point of care, to view a longitudinal patient record (integrated from across all available sources) across care episodes. This innovation

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has significantly improved the user experience in viewing clinical data and enabling "meaningful use" where it matters most---in the care pathway.

Thomson Reuters HIE Advantage, the fusion of Thomson Reuters robust healthcare information resources with CareEvolution's HIE platform, can bring to SHARE a proven and timely solution that delivers:

1. **A Proven, Hybrid HIE Technology Backbone**

   Thomson Reuters HIE Advantage provides a flexible and scalable technology platform for HIE deployment. It is a federated service oriented architecture that connects fragmented clinical and administrative data to deliver a unified, integrated, and analytically ready view of patient's entire care continuum. Purpose specific anonymized and sanctioned (public health reporting use case) aggregated data repositories can be created that supports the creation of meaningful use measures, quality and compliance reporting, and analytical and reporting services.

   This hybrid approach is ideal for accommodating a variety of SHARE's phased objectives, ranging from Phase 1 requirements for establishing the statewide backbone, to Phase 2 requirements for community level applications to empower physicians and other clinicians, and Phase 3 requirements for deepening the HIE's reach and sophistication.

   The key components of our HIE Advantage include:

   - An advanced, highly secure Record Locator Service and Master Patient Index (RLS/MPI) that provides standardized linkage in the distributed system by using a blinded directory for centralized demographic data. A set of security techniques are implemented to cryptographically (one-way) hash the aggregated data to ensure that patient demographic data stored in the centralized index is unrecoverable. Thomson Reuters is a recognized expert in the field of record linking (RL) given its 20+ year track record is performing this function for various federal agencies.
   - Adapters that are tailored to each clinical and administrative data source and serve as the "on-ramp" to the central backbone. Each Adapter is composed of a comprehensive stack of data services that enable interoperability and establish data standards through the network.
     - **Record Index Service:** Provides the interface between the host systems and the Record Locator Service. It standardizes and blinds demographic information before sending requests to the Record Locator Service.
     - **Data Transfer Service:** Manages adapter to adapter communication of clinical information. This is managed in pure peer-to-peer fashion.
     - **Clinical Data Interface Service (CDIS):** Hosts a set of pluggable drivers for communication with an institution's local clinical data sources such as EMR, lab, or pharmacy systems. The CDIS allows for easy customization to support the

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disparate clinical data sources of each institution. Each driver may run in one or more threads or processes dependent on the available hardware and required workload.

  - **Terminology Service:** Used by the Data Transfer Service and CDIS to provide translation between local (legacy) and standardized nomenclatures.

  - **Local Data Cache:** If needed, the Adapter provides a data store in which both record location index information and clinical information is cached. The Local Data Cache may be a single physical DBMS or can be federated across multiple physical databases.

- A comprehensive **Care Coordination Platform** that supports and facilitates a wide range of daily care functions, including patient inquiry, messaging, referrals, and ePrescribe. Additionally, supported by centralized reporting functions, the Care Coordination Platform can produce public health alerts and reports, including feeds for immunization and disease reporting, or maintenance of a patient registry

- A **Continuity of Care Viewer** that provides a real time summary of patient data from across many sources of care, for use by their clinicians and other authorized care givers to facilitate and improve real-time clinical decision making. The summarization of longitudinal, clinical data can be daunting, especially for patients with co-morbidities or complex chronic conditions. By applying our Medical Episode Grouping methodologies, complex, longitudinal patient data can be grouped and condensed into more actionable and meaningful data displays.

- A **Centralized Decision Support Database** of select clinical and administrative data can be continually updated and refreshed to monitor the overall clinical and financial performance of the network, and to enable analytics and reporting within and across Community HIEs. It is envisioned that this repository can also serve as a means of measuring meaningful use throughout the state in terms of quality and efficiency, in addition to deriving best practice norms across the network**.**

- A **Personal Health Insights Portal** that can function either as a “medical home” to augment patient/physician interaction, or as a reference center that provides each citizen a place to view their personal data in the network, access transparency data on healthcare quality and cost throughout the State, and personalized decision support for wellness, disease management, and chronic disease management.

- **Advanced Applications** like Surescripts certified ePrescribe and a Web-based ThinEMR that allows for encounter recording and care coordination.

2. Proven interoperability and terminology standards that comply with NHIN, HITECH, ARRA and other standards

Whether SNOMED, UMLS, LOINC, or any other standard being required or recommended by Federal agencies, HIE Advantage has been designed to not only address these

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standards, but also to be updated to address new standards as they emerge. The place where this requirement manifests itself most acutely is in the management of terminology standards. The Terminology Service that is built into each Adapter is tightly integrated with the Clinical Data Interface Service and the Data Transfer Service in order to provide translations to and from vocabularies supported by the UMLS Metathesaurus as clinical data moves through the network. A set of tools are provided to create and manage these translations.

3. **A cost-effective implementation framework to enable phasing and incremental expansion**

   HIE Advantage has been designed with a commercial off-the-shelf (COTS) product architecture to optimize deliverables and minimize the need to spend scarce dollars on one-off consulting, project design and custom development. Whether it be existing HL7 message traffic, WAN/network standards, or security policies, HIE technology should not force change. Policy, privacy, security, governance, compliance, and clinical value, and not the requirements of technology vendors, should drive the IT agenda. This means a greater emphasis on the ability to iterate.

   Given that most HIEs operate within nascent organizational constructs, an HIE technology platform must support a highly incremental approach, and not require disruptive change. This also means the SHARE solution must also be able to allow a-la-carte adoption. While we believe a holistic platform covering the gamut of technology components needed for effective HIE deployment is necessary, we notice that different participants in a given HIE have divergent needs. Not all participants need all or the same technology components to participate in the HIE. As such, the technology platform needs to be able to be adopted piecemeal on an as needed basis.

4. **Solving the Adoption Problem – Seed the Exchange with Content**

   Typically, HIE efforts struggle with the chicken or the egg syndrome: HIE's need data to attract participants but participants want the HIE to have data so they have a reason to engage. HIE Advantage has been designed to launch an HIE through a combination of a "broad & shallow" and "narrow but deep" data approaches. Wherever possible, we anchor our initiative with a "broad but shallow" starting point by leveraging state- or region-wide historical claims data (Medicaid claims, UB04, or other all-payer sources) to cover a very large patient population, but with shallow depth of information for each consumer. Such datasets are ideal in early phases to erect a viable state-wide RLS/MPI and a basic continuity of care viewer reverse engineered from the claims information.

   Simultaneously, we recruit provider organizations, reference labs, and prescription history sources to supplement the shallow data with these deeper clinical data assets. The resulting "network effect" provides exponential value to each incremental member but relies on a single participant to take the first step – the claims history ensures that we don't suffer from the "empty HIE" syndrome.

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Whether broad/shallow or narrow/deep, HIE Advantage can be deployed in either direction, and can even handle the pursuit of both approaches concurrently. The key to this flexibility is in the consistency of the underlying adapters and exchange standards that are deployed.

5. **Highly Scalable**

Typically, each region begins with the dominant providers and stakeholders launching a pilot phase with limited scope, growing to a larger implementation encompassing several participating institutions. SHARE desires the ability to eventually share information across multiple HIEs and many institutions, both public and private. The ideal backbone architecture would support a small scale deployment, allow for maximum reuse of initial hardware investments as the system grows, and deliver adequate performance to the full scale system as it matures.

HIE Advantage components have been designed and built to both scale up and out. These components use a tasking and queuing architecture that effectively quantizes the work done by the system. Components operate with a configurable number of threads on task queues to allow for *scaling up* on a single multiprocessor machine. Additionally, multiple instances of these components can operate on multiple machines, therefore allowing for *scaling out*. This allows independent tasks to be processed in parallel. Given this design, HIE Advantage can also "scale down." It can be fully deployed with a minimal hardware footprint. Because components do not have conflicting resource requirements, all components can successfully be deployed together on a single hardware footprint.

6. **World Class Security and Privacy**

Audit logging is an important part of a complete security infrastructure. But for auditing to be effective, the system must be designed and implemented so that there are no "back doors" that subvert the logging system. HIE Advantage locks down database access such that administrators cannot query the store without audit. In addition, the audit log itself is implemented with minimal permission, as access to this store can provide a significant amount of information. Thomson Reuters HIE Advantage implements industry best-practice to provide a complete security picture.

7. **Cost Effective Maintenance.**

The HIE Advantage COTS architecture facilitates cost-effective, ongoing maintenance. Whether adapting to changes in NHIN standards, new systems at the provider level, new methods on the Community HIE level, or new requirements for quality and compliance reporting, HIE Advantage brings the economies of scale only COTS architecture can.

8. **Comprehensive Data, Analytical and Reporting Capabilities.**

HIE Advantage is supported by the world-class healthcare decision support resources of Thomson Reuters. In creating the fusion between CareEvolution and Thomson Reuters, we have undergirded an HIE platform with the ability to link clinical and administrative data, apply data standardization that enables analytical readiness, select specific clinical and

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administrative data fields for a centralized decision support database, and develop reliable measures for evaluating and demonstrating meaningful use, measuring quality outcomes, and validating cost savings. Additionally, we mine retrospective data to apply evidence-based guidelines and identifying care practices that can be improved to increase quality and safety. These findings can be inserted back into the HIE and then embedded into point of care systems to support decision making between providers, clinicians and patients.

At the foundation of all we do with the HIE Advantage are the following core competencies:

- **Database Management**: We integrate and organize data across multiple sources to support clinical and management decisions. Our experience is comprehensive, ranging from single source databases to some of the largest, most complex, and diverse databases in the industry.
- **Data Aggregation and Interpretation for Meaningful Use**: One of our core competencies is providing data aggregation and interpretation services that make data meaningful for decision making and meaningful use measures.
- **Methods and Analysis**: We enhance the decision-making value of our customers' data using advanced methods, many of which we developed that are now standard in the industry.
- **Information Assets**: We have some of the largest and highest quality proprietary healthcare databases in the world to support benchmarking, modeling, strategic planning, and healthcare research.
- **Software Applications**: Our business focus keeps applications relevant to support day-to-day decision-making. We continually update our software to remain at the leading edge with advances in the industry.
- **Research**: Areas of focus include disease management, performance improvement, patient safety, and medical errors, healthcare for the elderly and chronically ill, behavior and mental health, organizational effectiveness, and international work.
- **Service:** We believe leading-edge products must be supported by exceptional service and are recognized for the service we provide by our customers year after year. We work with our customers as partners to ensure that the applications and services we provide address their business challenges and bring value to the entire organization.
- **People**: We seek out the best in the industry and our employees are consistently identified by customers as the number one reason for selecting and developing long-term relationships with us. We employ approximately 2,000 people possessing extensive experience in healthcare, research, and technology. Our professional staff includes individuals with backgrounds in medicine, pharmacy, epidemiology, quantitative analysis, healthcare administration, benefit design, health information systems, and data warehousing.

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4. List of Current Installed Locations for the recommended solution

CLIENT PROFILE	PRIME THOMSON REUTERS	SUB CAREEVOLUTION	SUB CIBER
Representative Accounts	North Carolina Hospital Surveillance System	South Carolina Health Information Exchange Lakelands Rural Health Network Community Health Network Connecting Communities of CareEvolution AccessNET Parkview Health	State of Tennessee Statewide HIE Initiative (consulting and project management) Centers for Disease Control (CDC) (development of emergency response information exchange system)
Key Highlights	Clinical Xpert Navigator platform is currently installed in 118 customers, representing 251 hospitals in 31 states	SCHIEx – South Carolina Health Information Exchange serves as the SC's SDE statewide technology infrastructure	CIBER has worked with more than 300 State Health agencies, hospital networks and life sciences clients.

CIBER's Arkansas Experience

Experience with State Agencies within Arkansas

CIBER has strong relationship with Agencies within the State of Arkansas where they have been doing work for over 30 years. Their work with the State of Arkansas includes both project-based work as well as staff augmentation services with many different state agencies, including two which will be impacted by the HIE initiative:

1. **Arkansas Department of Human Services (DHS)**

   CIBER has an ongoing working relationship with DHS. Many years ago, CIBER worked with DHS to transfer the State of Oklahoma Department of Human Services Automated Child Welfare System to DHS, which became known as the CHRIS project. During the course of this project, CIBER worked with DHS to transfer the system and to make the necessary customizations for the State. The CHRIS system is still in use by DHS today.

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Additionally, CIBER is DHS' trusted advisor for its annual security assessments. These assessments involve a full end-to-end review of physical and non-physical security threats across the main campus and off-site locations.

2. **Arkansas Department of Finance and Administration (DFA)**

   CIBER has been working closely with DFA for over 10 years. CIBER's team of consultants works closely with DFA for everything from new legislative updates that must be implemented in a two month period of time to helping them upgrade systems such as the Department of Motor Vehicles Licensing and Tag Renewal System. CIBER's team of consultants is an integral part of DFA's team of information technology professionals.

HIE Advantage Representative Projects

The South Carolina Health Information Exchange (SCHIEx) is the most recent and largest deployment of HIE Advantage. SCHIEx is an innovative statewide initiative that provides a state level info-highway that connects local health care providers and stakeholder groups to each other across the state. Seeded with claims data, SCHIEx is built on a federated architecture that delivers a 10-year health history of more than 6 million citizens of the state inferred from Medicaid and UB92/HCFA1500 claims. This broad dataset covering the entire state is supplemented by deep clinical data adapters that connect national lab vendors, prescription history sources, the state immunization registry, and local and regional EMR enabled health care providers. In addition to serving as a Longitudinal Health Record portal, the project serves as a statewide record locator service (RLS) that is being used by emerging regional health information exchanges across the state.

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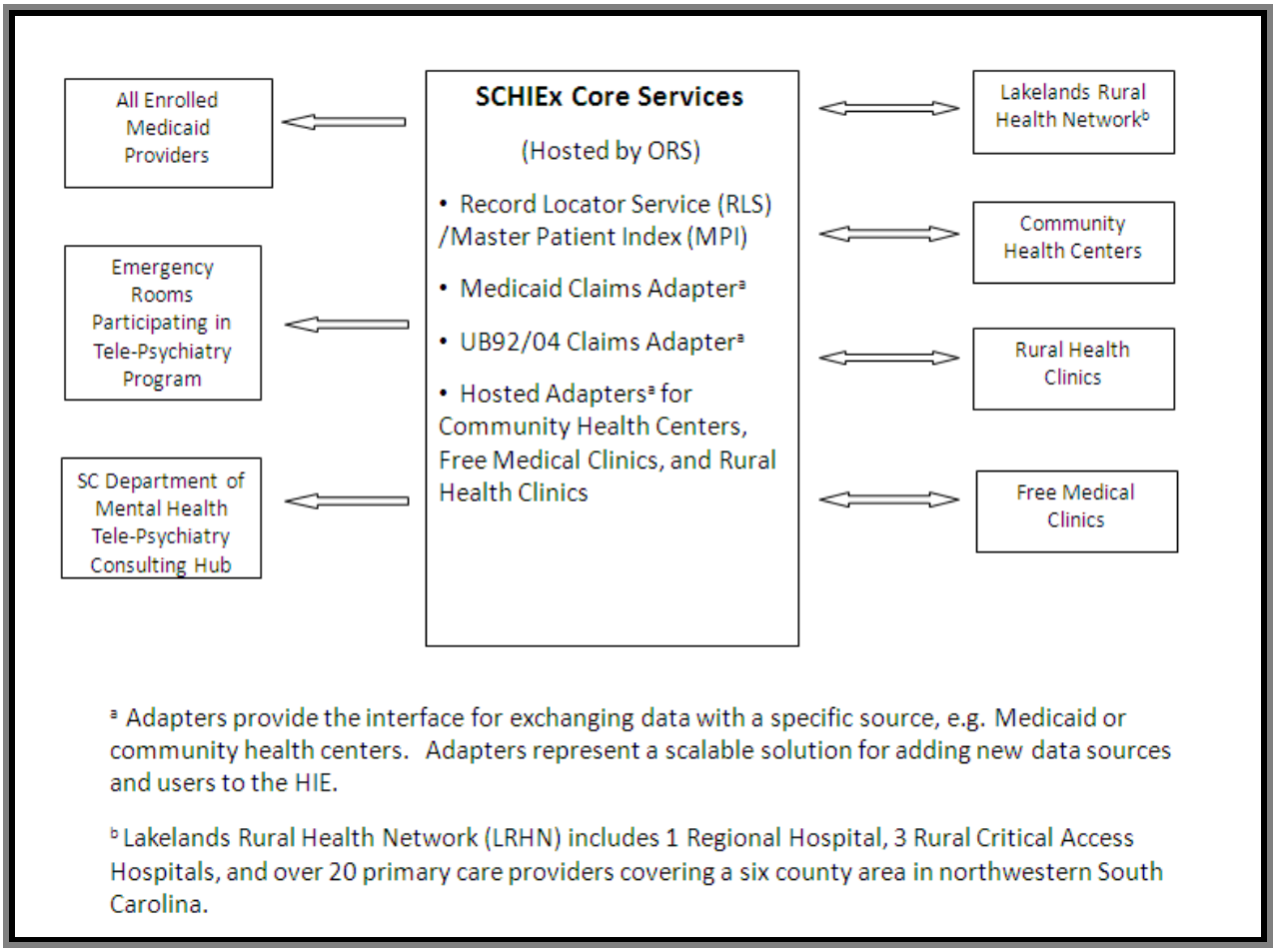
Figure 1



Sponsored by the South Carolina Department of Health and Human Services that administers Medicaid in the State, the SC Hospital Association, the SC Free Clinic Association, the SC FQHC's, and the SC Primary Care Association, the project is being rolled out to over 8,000 care providers. Today SCHIEx is the Governor-appointed official statewide exchange and the "interstate" around which local exchange "neighborhoods" are being built.

SCHIEx is the underpinning for the Statewide Telepsychiatry initiative, it supports local HIE efforts like the Lakelands Rural Health Network, and is being supported by the Duke Endowment and Blue Cross Foundation for a care coordination platform extension for the under and un-insured population in the State. Our work in South Carolina has been recognized by the eHealth Initiative, TEPR, Microsoft, and most notably the National Governor's Association eHealth Task Force as a best practice.

Our directly applicable experience provides us with a uniquely qualified perspective and competence in being able to execute the scope of work contemplated by the SHARE initiative.

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Despite marketing claims to the contrary, independent due diligence will reveal that there are very few operational, state-wide, exchanges that have both State agency and provider data source participants. Several have been announced, some are close to achieving early operational status, but none have achieved it to the extent our team has in South Carolina. We urge the SHARE team to take a critical view of the results achieved in South Carolina.

Beyond the technology we bring a unique and successful approach to working with multi-stakeholder projects particularly those that require public and private sector collaboration.

Starting with the HIE Advantage our end-to-end, SOA-based interoperability technology stack, we are able to focus on the real issues of implementation rather than "coding" on the fly during the implementation.

Thomson Reuters HIE Advantage has been adopted by regional health information organizations, state wide interoperability initiatives, and large integrated delivery networks to "connect their data dots". It is not an extension to an EMR, or a clinical messaging solution recast as a holistic platform, but rather a vendor agnostic, service oriented architecture (SOA) based, comprehensive technology stack for interoperability. Thomson Reuters HIE Advantage is modeled after the Markle Foundation's Connecting for Health Framework and as such is designed from the ground up to be implemented in the hybrid (centralized and/or federated) manner that Passport HIE specifies. With this comprehensive technology stack, we are able to provide a comprehensive solution to extract clinical data from legacy systems, rationalize patient identity, and reconcile terminology differences amongst HIE participants, accommodate complex privacy/data sharing policies, and maintain a holistic audit history to transform islands of automation into standards-compliant, interoperable nodes in a network.

Our work in the State of South Carolina closely matches the SHARE vision and desired architectural framework. Powered by Thomson Reuters HIE Advantage, the South Carolina Health Information Exchange (SCHIEx), recently officially designated as the SDE, is an innovative and highly efficient approach for deploying a statewide "Network of Networks" model called for by the NHIN. SCHIEx is built on a commercial off-the-shelf software (COTS) technology stack that uses a federated service oriented architecture (SOA), to deliver a standards compliant enterprise service bus to deploy and operate a statewide HIE.

The block diagram in **Figure 1** provides a high level view of the SCHIEx design; a service oriented architecture (SOA) technology stack that provides comprehensive but modular tools to deploy and operate a health information exchange. SCHIEx layers can be implemented in hybrid (federated/centralized) deployment models to best meet the specific needs to rationalize patient identity, create a unified patient health record, and deliver multiple "views" (consumer, provider, researcher) of the resulting interoperable data.

Since the SCHIEx RLS supports the Inter SNO Bridge design from Markle and IHE PIX/PDQ, this design is able to fully support a loosely distributed model where there are actually multiple Record Locator Services (RLS) coexisting, even from multiple MPI vendors. Even though South Carolina only uses HIE Advantage CryptoRLS™, this capability is critical in participating with adjacent states

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and the NHIN. We are actively working with the Federal Health Architecture CONNECT 2.2 SDK to support inter-HIE and state to federal systems connectivity using the CONNECT platform.

Key items of note in this architecture are its flexibility and compliance with emerging standards:

- SCHIEx supports a federated model where the edge system Adapters are physically located adjacent the source. For example the Hospital 1 adapter could be located in the data center at the hospital. It would communicate via encrypted traffic to the RLS located at the data center over the internet.
- System can accommodate a centralized model by physically implementing each adapter at a single hosted site.
- A record locator service (RLS) serves as the central switchboard for all systems and consumer transactions
- There is no centralized aggregate store of decipherable PHI information. Anonymization is strongly enforced. Reidentifying data requires the aggregate store to submit an authorized request back to contributing site of the data.
- Optionally, non PHI/anonymized data can be aggregated centrally as a feeder to the advanced business intelligence tools to support population health, research, biosurveillance and predictive modeling applications.

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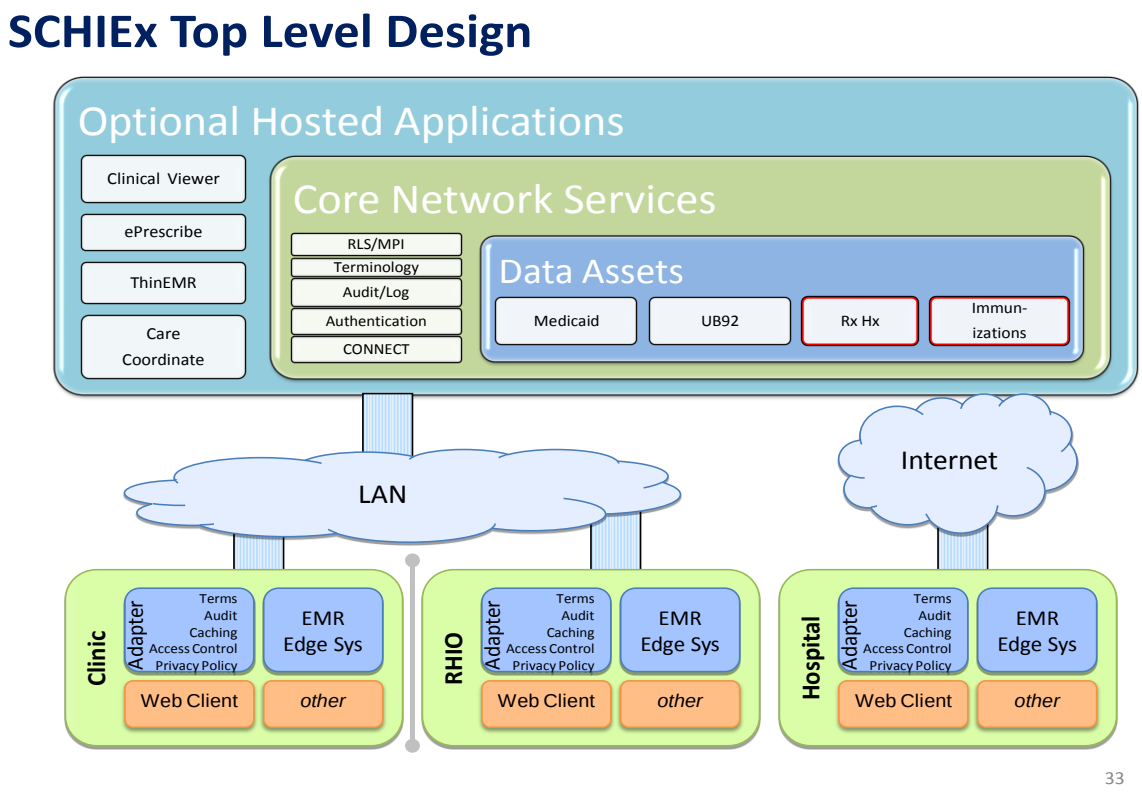
Figure 2



CIBER Systems Integration Experience

CIBER Healthcare Experience

CIBER does work with all sectors of the healthcare industry. Representative CIBER healthcare customers have included:

The Mayo Clinic, Clarian Health Partners, Hawaii Health, MedStar Health, San Francisco General Hospital, The Children's Hospital, University of Pittsburgh Medical Center, the Visiting Nurses of New York, Humana, UPMC Health Plan, Magellan Health Services and Kaiser Permanente, United Healthcare, Novartis, Abbott, Bayer, Aventis, GlaxoSmithKline, Pfizer, Schering-Plough and Sunrise Medical American Red Cross, U.S. Department of Health and Human Services, Veteran's Administration, Departments of Health for states of Pennsylvania, North Dakota, Iowa, Wisconsin, Louisiana; Womack Army Hospital, City and County of San Francisco, Centers for Disease Control and Prevention, Joint Commission of Health Care Organizations (JCAHO) and Texas Cancer Council

- More than 150 healthcare providers
- 12 of the top 15 pharmaceutical companies
- More than 85 life sciences manufacturers/distributors
- 6 of the top 10 national managed care companies

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- More than 100 government and/or non-profit health organizations

CIBER has an estimated 700 employees working with customers in the healthcare sector. Our pool of personnel with healthcare project experience and technical expertise adds to our capabilities to support HIE projects.

Because of CIBER's extensive work in the healthcare sector we have a solid understanding of the key national standards and best practices associated with the healthcare industry. These key standards and best practices include: HL7 standards, HIPAA standards, Federal ONC CCHIT standards, Public Health Info Network (PHIN) standards, National Health Information Network (NHIN) standards, Markle Foundation Privacy and Security best practices, Institute of Medicine Best Practices, Federal Enterprise Architecture standards, Public Health Certification Best Practices, etc.

CIBER Experience with the Centers for Disease Control

CIBER CDC Domestic Technical Operational and Professional Services (DTOPS)

1.				
	Customer Agency	Total Solutions, Inc. (TSI) (prime) (CIBER is subcontractor to TSI)		
	Contract Title	CDC Domestic Technical Operational and Professional Services (DTOPS)		
2.	Brief narrative description of the work performed	CIBER provides medical, technical, and scientific professionals to disseminate and to enhance program methodologies, evaluation techniques, institutional training, and health practices. This includes designing and developing training programs and materials and performing in-country technical assistance.		
	Discussion of any problems encountered and corrective actions	OCONUS travel is unique in its set of challenges. To manage these challenges and the inherent difficulties travel places upon our employees, we responded by developing mitigation strategies and providing specific administrative and project management support.		
	Significant accomplishments	CIBER personnel participated directly in establishing a School of Public Health in Ghana to train and build a robust public health workforce for Africa.		
3.	Dollar value	$10,500,000	Period of performance	09/2007 – 08/2012

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	Contract type	IDIQ with T&M Tasks	Number of personnel	17
	Place of Performance	Atlanta, Georgia, and OCONUS work (Ghana, Guatemala, South Africa, Tanzania, Uganda, Columbia, Malaysia, Croatia, Georgia, Ethiopia)		
	Types of personnel	Senior Public Health Training Specialist Instructional Designer Public Health Analyst Health Scientist Extramural Res. Management Specialist	Microbiologist Emergency Response Coordinator Pandemic Influenza Coordinator Physician/Epidemiologist Workforce Devel. Management Assistant	

CIBER Healthcare related experience with the State of Tennessee

State of Tennessee eHealth Initiatives and Health Planning Decision Support System

1.		
	Customer Agency	State of Tennessee
	Contract Title	State of Tennessee eHealth Initiative and Health Planning Decision Support System (DSS)
2.	Brief narrative description of the work performed	CIBER provided consulting and design services for a statewide health information exchange network, consulting and software selection for a statewide telehealth network, and designing and developing a data warehouse and decision support system. This included developing the designing the system, developing requirements for ePrescribing, developing a governance model and data stewardship guidelines, and developing, and implementing the first data mart of the decision support system.
	Discussion of any problems encountered and corrective actions	To address the lack of a statewide strategy for electronic health information exchange, CIBER helped develop the strategy for eHealth and was key in designing and developing a centralized data warehouse.
	Significant	Key accomplishments included developing a statewide eHealth and

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	accomplishments	telehealth strategy and architecture road map, researching health planning systems and statewide eHealth networks used by other states, documenting requirements for the statewide eHealth network and health planning decision support system.		
3.	Dollar value	$1,500,000	Period of performance	08/2005 – 2/2009
	Contract type	T&M	Number of personnel	5
	Place of Performance	Nashville, Tennessee		
	Types of personnel	Project Manager Solution Architect/Senior Business Analyst Business Intelligence Systems Analyst	Business Intelligence Systems Admin Technical Information Specialist	

5. Estimate of implementation timeline: Pilot project and broader installation.

While a "sample" project plan is requested and is provided as **Attachment A**, it is not applicable to SHARE's needs. It is Thomson Reuter's understanding that SHARE would like to implement their HIE backbone in a three phase process:

- Phase 1 –pilot/proof of concept
- Phase 2 –implementation/operational
- Phase 3 –sustainability

The attached sample implementation plan is provided simply to share our "depth and expertise" in this domain. We believe that SHARE's needs are distinct and foresee the following key high level milestones and elapsed time ranges.

- **Sept 2010 – Oct 2010**
  - Project Activation (team definition, detailed project scope definition, detailed project plan development, signoff)
  - Governance and Policy synchronization
  - Strategy formulation and phase participation/scope definition

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- **Oct 2010 – Feb 2011 – SHARE Core Infrastructure Services (suggested Phase I)**
  - Statewide RLS creation (Leverage Medicaid and claims assets to seed the RLS/MPI)
  - Statewide Immunization Registry Gateway implementation (presumes CDC specifications based gateway)
  - Statewide NHIN CONNECT gateway
  - Emulate viewer availability to review continuity of care view
- **Dec 2010 – Mar 2011 (deepen content and availability)**
  - Standards based SHARE HIE gateway – enable interested providers and EP's to "connect" to exchange if their EMR is HITSP interoperability compliant (CCD, PIX/PDQ/XDS)
  - Sponsored regional rollouts to large dominant providers
  - Reference laboratory (labcorp and quest gateways)
  - PBM Med history gateway (RxHub/Surescripts)
- **Apr 2011 – Oct 2011 (broaden reach and capability – Phase II)**
  - Public health reporting gateway
  - Self certification and connectivity harness rolled out to statewide providers
  - Existing HIE interoperability completed using either CONNECT or SHARE specific standard
  - Operationalize onramp for statewide providers who wish to join
- **Oct 2011 onward – expansion in depth and breadth (Phase III)**
  - Quality reporting gateway
  - Applications and facilities available for subscription to statewide providers

6. Description of the Financial Business Models supported.

The South Carolina Health Information Exchange (SCHIEx) Draft Strategic Plan captures one of our core beliefs we hold regarding Health Information Exchange. Namely, that "erecting a healthcare data utility is analogous to the cable TV industry. No subscriber wants to pay the cable company to pull coaxial cable to their street. As consumers, our interest is in the content or channels we receive from our cable company. Investments in the infrastructure must be made by the cable company largely on the leap of faith that, once completed, the marketplace will in fact find the capabilities (channels) enabled by the infrastructure useful. Healthcare is no different. No clinic or hospital

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wants to pay for the work of starting from scratch and pulling cable to every other hospital or clinic – nor should they. “

The Thomson Reuters team brings this thinking in the manner in which we design our technology, market it, price it, and support it. We believe projects like SHARE need to be undertaken with this “public utility” mindset. Like any other utility, the benefits are diffuse, yet costs are highly concentrated and often front-loaded. As with our previous HIE successes, we partner with our clients to significantly subsidize the front loaded costs to help jump-start the utility build-out. Though this procurement, like others in the industry, has a 5 year span, we model the financials and prospects over a much longer time horizon and provide a business proposition accordingly.

Additionally, Thomson Reuters has been actively tracking sustainability approaches throughout its client base and through external sources for over 15 years. Historically, many CHINs and RHIOs were started with grant dollars, with a rare handful of early adopters supported as provider-payer collaborations. Public health surveillance systems were funded separately and in isolation of CHINs or RHIOs. Given the lack of clinical data robustness, value-added services and analytics were rare and isolated. Additionally, no legislative or regulatory requirements requiring participation existed for providers.

In 2003, when HIPAA mandated Providers to submit claims electronically to CMS for payment processing, sustainability traction started change. HIPAA adopted certain standard transactions for Electronic Data Interchange (EDI) of health care data. The covered standard transactions included: claims and encounter information, payment and remittance advice, claims status, eligibility, enrollment and disenrollment, referrals. Ultimately the majority of payers across the US have adopted and mandated the federal Claims EDI standards. **For providers, claims EDI is a *pay-to-play proposition*. They pay claims EDI processors to perform claims EDI over their networks and face payment reductions from payers if they don’t submit claims using EDI.**

Now that the ARRA HITECH Act is underway, a similar dynamic is unfolding with HIEs. Once the Federal government mandates that certain functionality and standards are required to receive compensation or incentives, the market begins to adapt.

> “Because of the public-good nature of health information exchange, many experts believe that governmental support will be necessary to create and sustain mechanisms for EHR interoperability within and between local markets. There are two essential elements to making this data exchange happen. The first is to make sure all certified records have the capacity to exchange information—meaning that some group must set standards for packaging information and then require that EHRs conform to those standards. The second requirement is the development of an agency or group in local markets that forges connections among doctors, hospitals, laboratories, pharmacies, and other health care groups, and then facilitates the flow of information among these entities. Such a local body is necessary because the providers themselves have no financial incentive to make data exchange happen and, therefore, to sustain the capability for that exchange.

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Other alternatives: Medicare could compensate providers more for participating in data exchange, which would create a business case for doing so, or refuse to compensate them unless they participated in data exchange."

Source: D. Blumenthal, the Federal Role in Promoting Health Information Technology, The Commonwealth Fund, January 2009

HIEs are starting to become a "pay-to-participate" proposition (like power, phone, cable and the internet), but with a Medicare payment penalty for professionals and hospitals starting in 2015 for non-participation.

- Most states have published business plans for ***HIE sustainability***.
  - These sustainability models were required as part of the State Health Information Exchange Cooperative Agreement Program grants.
- Most states have proposed state-wide HIE sustainability in one or more of the following ways:
  - Providers pay for the state-wide HIE with costs allocated based on some formula and assessed as a fee or tax (Pennsylvania and Arizona)
  - Providers pay a connectivity fee based on provider type / size or by transaction (Missouri)
  - The state provides basic HIE connectivity as a "public utility" usually with a strong link to the state's Medicaid program. (South Carolina)
  - The state forms a quasi-governmental non-profit organization to build and manage the HIE (North Carolina)

    Source: Health Information Exchange (HIE) Business Models The Path to Sustainable Financial Success; Produced by the Deloitte Center for Health Solutions; August 2009

Case Study - NCHESS

In North Carolina, Thomson Reuters runs the nation's largest surveillance exchange—the North Carolina Emergency Surveillance System (NCHESS). At the inception of NCHESS in 2003-2004, the exchange got up and running through a combination of Federal and State grants that were funneled through the State to the North Carolina Hospital Association (NCHA). Over time, a formula was derived to sustain NCHESS on an annual basis through participation fees that are calculated based on Net Patient Revenue. Essentially, bigger hospitals pay more than smaller hospitals based on revenue capacity. NCHESS has been operational for over 5 years with more than 111 hospitals participating in the exchange. This demonstrates the success of the sustainability model of the initiative.

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Since 2006, the South Carolina Health Information Exchange (SCHIEx) which started as a public-private partnership and has successfully attracted funding from a multitude of sources to help build out the exchange infrastructure:

- 2007 - Blue Cross / Blue Shield Foundation Grant to bring all free clinics statewide onto the exchange
- 2007 - HRSA FLEX grant to bring about a regional rural HIE based on SCHIEx
- 2008 - Duke Endowment funding to use the platform to erect a telepsychiatry network across the state
- 2009 - HRSA Patient Navigation demonstration grant (one of 6 national patient navigation – PCMH demonstration projects funded by HRSA)
- 2010 – CMS CHIPRA Grant – one of 10 CHIPRA grant winners to demonstrate improvement in pediatric care using HIT
- 2010 – ONC HIE Cooperative Agreement Grant

Ongoing support and funding for the platform comes from four sources

- 2006 – ongoing: SC DHHS (Medicaid) agency provides ongoing funding to use the SCHIEx as its Medicaid HIE and patient history viewer. This contract with the agency that manages Medicaid (>800,000 consumers annually with a budget exceeding $5.5 billion) funds the core hosting and maintenance of the exchange infrastructure
- Optional: Per NPI fees for:
  - PQRI registry reporting
  - ePrescribe
- Optional: Per hospital fees for:
  - Pro-rated for “size” a nominal annual fee to connect to the exchange to participate in Immunization registry and public health reporting

7. Suggested Service Level Agreement terms.

Overview

Ability to submit, dynamically route, track and resolve support issues with ease.

Support Issues can be submitted via email, entered via the web or entered by using a dedicated toll-free telephone number to speak with a help desk technician.

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Receive automatic updates on the status of support requests via e-mail or check on the status of their request using intuitive browser based portal.

With each call, help desk technicians will create and maintain a knowledge base of common support requests and their resolutions. This knowledge base will be searchable by both helpdesk technicians and helpdesk personnel. Over time, this knowledge base will help reduce the time to resolve support issues.

Staff the support center during regular business hours (8:00 AM to 5:00 PM Eastern) Monday through Friday excluding state holidays.

Support Level Categories

- **Urgent:** The problem affects a group of users and demonstrates one or more of these characteristics: a major function is not usable or presents incorrect results, the problem cannot be easily avoided, usability of the system is significantly affected, or a workaround is impossible or difficult. Examples include system crash, hang, or inability to access or operate the system.
- **High:** The problem affects a single user and demonstrates one or more of these characteristics: a major function is not usable or presents incorrect results, the problem cannot be easily avoided, usability of the system is significantly affected, or a workaround is impossible or difficult. Examples include data loss or corruption, or failure of a critical function to operate.
- **Medium:** The problem affects a single user and demonstrates one or more of these characteristics: a notable discrepancy exists within the function, the problem cannot be easily avoided, or usability of the system is not significantly affected. Examples include operation that is not exactly as defined or the user requires information that Level 1 support cannot provide.
- **Low:** The problem does not require immediate attention because the usability of the system is not affected. This may include issues such a misspelled word, an inconsistent format of a screen or report.

Service Level Agreements

Service Level Agreements are the specific measurements by which Service performance is measured each month.

METRIC SERVICE LEVEL DESCRIPTION SLA

Call Routing Availability

- Phone system is available and calls can be taken.
- Availability is defined in the Glossary.
- Communications carrier outages shall not be included in the calculation.
- Alert customer to any scheduled maintenance that may be required on the systems.
- 99.9%

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Help Desk System Availability

- Help Desk system is available to enter requests and to check the status of requests.
- Alert customer to any scheduled maintenance that may be required on the systems 99.9%

Help Desk Speed of Answer

- The percentage of Calls that are answered by a Help Desk Analyst in less than or equal to 60 seconds divided by the total number of calls answered by the Help Desk in the month.
- Measurement begins upon completion of front end message and first ring.
- 85% in <= 60 Sec

First Call Incident Resolution

- First Call Resolution rate on Incidents categorized as First Call Eligible (Resolvable). Incidents that are not First Call Eligible (Resolvable) shall not be included in the calculation of this metric.
- First Call Incident Resolution shall be calculated as the total number of incidents that can be resolved by Level 1 support, divided by the total number of First Call Eligible Incidents reported to the Help Desk during the month, with the result expressed as a percentage to two (2) decimal places. Note: First Call Eligible Incidents will be defined and documented prior to pilot rollout.
- >= 80%

Email to Ticket Conversion

- Emails will be converted to a Ticket within 30 minutes of receipt at the Help Desk 85% of time. Measured by Time Stamp on email. Exceptions: All subsequent troubleshooting and proper resolver group routing are excluded from this timing metric.
- >=90%
- <= 30 minutes

"Urgent" Problem Resolution Time

- Reported problems classified as "Urgent" will be resolved within 2 business hours 80% of the time.
- >=80%
- <= 2 business hours

"High" Problem Resolution Time

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- Reported problems classified as “High” will be resolved within 4 business hours 80% of the time.
- >=80%
- <= 4 business hours

“Medium” Problem Resolution Time

- Reported problems classified as “Medium” will be resolved within 48 hours 80% of the time.
- >=80%
- <= 48 hours

“Low “ Problem Resolution Time

- Reported problems classified as “Low” will be resolved in the next scheduled release of the system

ONGOING SUPPORT SERVICES TABLE

Project Management

Systems Analysis, Architecture and Design

System Integration and Testing

System Development

Operations Support

Business Process Redesign

Stakeholder Services and Support

Training (including User Documentation)

Data Center/Hosting Services

Data centers are designed and outfitted to meet the most stringent requirements and have passed rigorous SAS 70 Type II testing.

Data centers are secure, state-of-the-art facilities that provide these capabilities:

- Load-balanced, redundant Uninterruptible Power Supply (UPS)
- Two 30 ampere circuits in each equipment cabinet
- Climate control through multi-stage, air-handling units
- Diverse, routed fiber network
- Multiple T3 (45 Mbps) to Internet via UUNET & Sprint
- 24/7/365 staff

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- Advanced perimeter security system monitored by ADT and Certified Protection
- 21 CFR Part 11 Compliant
- Certified SAP global hosting partner (one of five worldwide)
- AMS Certified
- ITIL / ITSM Compliance Strategy
- Change management processes
- N+1 Redundancy throughout facility
- Commercial Power, UPS & Diesel generators
- HVAC
- Pre-action sprinkler system
- FM 200 or Inergen fire suppression
- Diverse, routed fiber network
- OC3, OC12, STM-1 fiber multiplexers
- Multiple DS3 & Metro-E to Internet

Availability of Fully Managed data center services- These services are provided for customers who require full support of their computer / networked systems in the area of operational, technical and administrative support. Fully Managed data center services includes technical support for computer servers, operating systems, database, firewall, and Internet connectivity with the addition of full responsibility of all hardware, software and firmware and all administration aspects including licensing and maintenance.

Application, Network and Systems Monitoring

Use of advanced system for the enterprise management of the end-to-end HIE solution infrastructure with a single solution including the following:

- Application Monitoring
  - Oracle / SQL Databases
  - Messaging Systems
  - Job Scheduling
  - Web Services
- HIE Application
- Network Monitoring
  - Routers
  - Switches
  - Firewalls
- Systems Monitoring
  - Operating Systems
  - Server Hardware
  - Storage
  - Backup Server and Jobs
- LAN/WAN management.
- Faults can be prioritized based on the importance of the services that are affected

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- Real-time alarms are generated, warning of service outages and impending SLA violations, including the root cause allowing them to be addressed quickly before the business is severely impacted
- Includes real-time views into the performance and health of critical systems
- Integrate real-time content with historical performance, support a natural workflow for identifying and resolving problems that might otherwise bring down critical systems and applications

8. Estimated Cost of Solution Components, including license fees, third-party license fees, hardware (server and storage), and recurring maintenance fees

As mentioned earlier, we approach this space with a "public utility" mindset. We need to ensure that the up-front pricing for erecting the infrastructure is amortized over the 10-20 year life of the system. Many of our peers view the HIE space as the new health IT "gold rush" with an attempt to maximize near term revenues. We believe this is a poor business decision. It is our conclusion that the "long view" is a better business strategy and our pricing reflects that thesis.

We believe that 4 year costs for hosting, services, software, and incidentals should be between $7-9 Million for the core infrastructure and optional value add applications that would offered on a subscription model to adopting providers.

Our model minimizes the upfront investment necessary to "launch" a successful exchange. We go at-risk for true sustainability of the exchange with the adopting organization. This model has served us well over the last 5 years. Beyond the HITECH HIT incentive horizon, we believe that healthcare reform will provide obvious ROI/sustainability options for effective exchange as providers are compelled to deliver services in the ACO landscape. In this context, we are even more ardent believers that HIE infrastructure build out and one time connectivity costs should be subsidized.

In the prototype scenario provided we see four cost buckets:

1. Implementation Fees, including analysis and design, build, validation, implementation and post implementation assessment and optimization phases
2. Training
3. Hosting Fees
4. HelpDesk Fees

If SHARE were to consider an implementation of an integrated MMIS and HIE solution, the State would be able to leverage the significant funding contributions that CMS provides for Medicaid programs. The federal matching funds could represent a significant cost savings to the State when

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compared to the cost of supporting the standalone HIE, even with some one-time grant funding to help get it started. The savings would be both for the build-out of the HIE as well as a portion of ongoing administration support for the HIE members that are also Medicaid beneficiaries. The matching funds, and therefore the savings would be:

1. Design, Development and Implementation (DDI)– Reimbursed to Medicaid at a 90% match.

   Funds expended to build and host the Medicaid HIE would be covered by a 90/10 federal match. Most of the DDI work for a Medicaid HIE would be identical to the effort for the stand alone HIE.

2. Administration – 75% federal match

   Costs related to maintaining the HIE for ongoing operations in support of Medicaid beneficiaries would be federally matched at 75%. Given Arkansas sizable Medicaid population, this represents substantial ongoing savings to the State, especially given the 10-20 year life expectancy for the HIE program.

Integrating the HIE project with the MMIS has the potential to save Arkansas substantial dollars in both the DDI phase, and in ongoing operations. With the economic challenges faced by State governments nationwide, these savings can have positive budgetary impacts for Arkansas well into the future.

5.2 General Solution Description

1. Interoperability

Thomson Reuters HIE Advantage is the only technology stack in the industry to attempt and obtain IHE (Integrating the Healthcare Enterprise) certification during the 2007/2008 IHE Connectathon/HIMSS Interoperability Showcase. Results from our IHE testing are available at the IHE Web site under CareEvolution. We recently completed the IHE 2010 Connectathon where our underlying technology platform (CareEvolution HIE Advantage™) successfully passed all 70 tests to be able to offer out of box connectivity using PIX/PDQ and XDS profiles to edge EMR systems.

IHE is a HITSP ratified standard and is now the required set of Interoperability features that EMR vendors must comply with to maintain CCHIT certification in 2009. While very few existing EMR sites have IHE compliant legacy systems, we anticipate that our continued investment in maintaining IHE compliance will serve SHARE well over the mid- to long-term.

We maintain the following checklist to ensure we are following the appropriate data sharing and communications procedures:

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	EXCHANGE STANDARDS CHECKLIST		
DATA EXCHANGE TYPE	**PROPOSED STANDARD**		**COMMENTS**
Demographics	Exchange Standard Vocabulary	HL7 version 2.4 or higher	2.3 or later is supported fo all
Medications	Exchange Standard Vocabulary	HL7 version 2.4 or higher NCPDP (retail pharmacy) NDF-RT, RxNorm (inpatient pharmacy) AHFS, NDC, FDB	
Problem/Symptom	Exchange Standard Vocabulary	HL7 version 2.4 or higher ICD9-CM, SNOMED CT	
Major Procedures	Exchange Standard Vocabulary	HL7 version 2.4 or higher CPT-4, HCPCS, SNOMED CT	
Immunizations	Exchange Standard Vocabulary	HL7 version 2.4 or higher CPT-4, SNOMED CT	
Allergies	Exchange Standard Vocabulary	HL7 version 2.4 or higher Free text, SNOMED CT (reaction), Medications (see above), Unique Ingredient Identifier (UNII) for environment/food	

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	EXCHANGE STANDARDS CHECKLIST		
DATA EXCHANGE TYPE	**PROPOSED STANDARD**		**COMMENTS**
Hospital/ Physician Visi	Exchange Standard	HL7 version 2.4 or higher	
	Vocabulary	ICD-9-CM (physician), HL7 version 2.4 (hospital)	
Lab/Micro/Rad Reports	Exchange Standard	HL7 version 2.4 or higher	2.5 is preferred. It is the ne HITSP ratified standard.
	Vocabulary	CPT-4, LOINC (lab/micro order names), SNOMED CT (lab/micro results), DICOM (images, faxes)	

The Last Mile – Connecting Legacy EMR/EHR to the HIE

Every organization that wishes to participate in health information exchange (HIE) by definition has an existing suite of healthcare IT applications such as claims systems, lab, radiology, registration, EMR, and dictation. Each of these systems in turn has its own functional capabilities, data formats, and levels of standards compliance. One of the core value propositions of the HIE Advantage is to integrate these heterogeneous data sources and enable data sharing between other health organizations on the HIE Advantage. Our HIE Advantage provides a clinical data integration service that minimizes custom engineering work needed to integrate clinical data sources while maximizing the flexibility and manageability as its clinical data systems evolve.

Even within organizations, clinical data integration is a major challenge. The problem has typically been addressed by utilizing HL7 integration servers such as SeeBeyond's eGate or Microsoft's BizTalk Server. These integration servers provide rule-based routing of HL7 messages, data transformations, architecture for custom adapters for custom data sources, and other features. Integration servers are then configured and modified so that live data feeds from various clinical data sources are streamed to applications such as a clinical data repository (CDR) for visualization and inspection by clinical staff.

While these capabilities should be leveraged when constructing a HIE platform, they are not wholly sufficient to address cross-organizational data integration. In order to share complete medical histories, a service is needed to query both existing data stores in real time and pre-loaded historical data. HL7 Query-Response would be ideally suited to handle this problem but is not consistently implemented in

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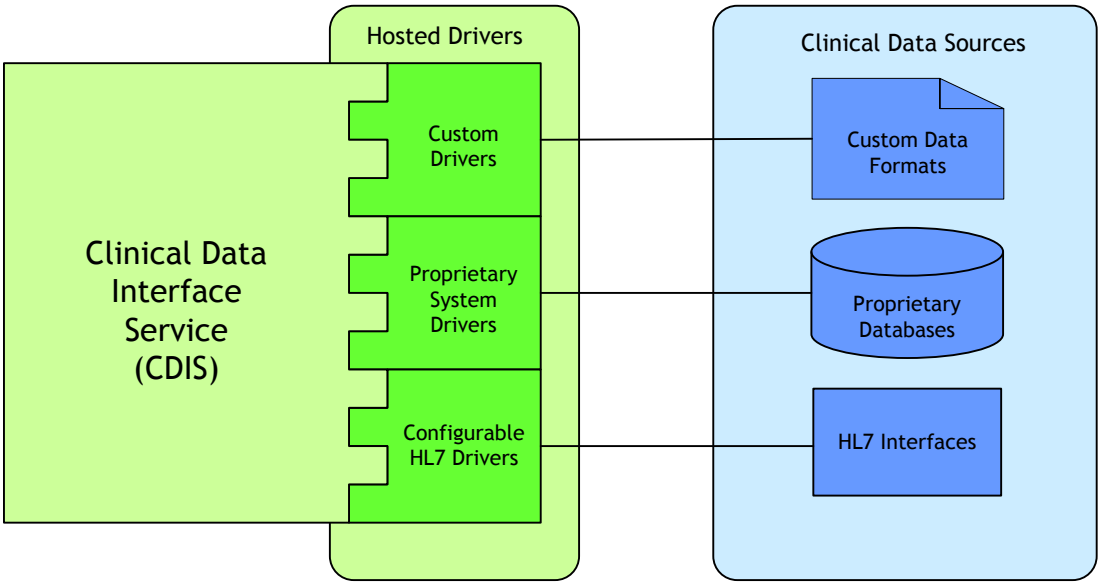
clinical data systems. The following discusses our seasoned approach in such instances (which are the rule rather than the exception).

In the absence of clinical data sources with query-response capabilities, a key function of the HIE Advantage is the ability to integrate real time interfaces and historical loads to provide a complete medical history for sharing across a HIE. The HIE Advantage Clinical Data Interface Service does this by providing a pluggable architecture that integrates with live interfaces and historical data extracts and then stores that data for future, secure sharing based on our identity management services.

Our Approach to Clinical Data Integration

The core component of Thomson Reuters HIE Advantage that enables clinical data integration is the Clinical Data Interface Service (CDIS). The CDIS is a dynamic, pluggable architecture that allows drivers to be loaded to interact with existing clinical data sources. A driver is a reusable software component that is written and/or configured to enable integration between the Thomson Reuters adapter and a particular clinical data source, such as lab or registration system.

Figure 3



The hosted, componentized nature of the driver confers a number of advantages on the Thomson Reuters HIE Advantage:

- **Reuse:** Once a driver has been written or configured for a particular clinical data system, this driver can be reused at other health organizations that also use that clinical data system.
- **Modularity:** Adding, removing, or changing a driver is a matter of reconfiguration, not reinstallation. Clinical Data Sources can be changed and retooled to adjust to the requirements of adopting organizations while minimizing impact on the existing installation.

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- **Isolation:** The complexity of integrating with preexisting clinical data sources is isolated to this part of the HIE Advantage. The CDIS completely isolates failures that occur in any given interface and logs them appropriately for resolution.

This architecture does not completely eliminate the need for custom engineering at adopting organizations. What this architecture does is address the reality that clinical data sources will run the gamut between standards-compliant, widely-used systems to homegrown, customized software particular to an organization. Drivers hosted within this architecture correspondingly vary on their level of reusability through the HIE Advantage network. We divide these drivers into three categories:

- **Standards-Based Drivers:** Drivers based on a clinical data standard (e.g., HL7, CCD, IHE) that can be configured to interact with an installation of a product that conforms to that standard.
- **Product-Based Drivers:** Drivers that are based on a particular product, and must be configured to interact with a particular installation of that product.
- **Isolation:** The complexity of integrating with preexisting clinical data sources is isolated to this part of the HIE Advantage. The CDIS completely isolates failures that occur in any given interface and logs them appropriately for resolution.

While custom drivers by definition will only be deployed to one site, our standards- and product-based drivers can be reused with appropriate configuration throughout the HIE Advantage network to facilitate faster implementation. HIE Advantage also provides a rich set of administrative tools to manage these drivers. This allows administrators to easily monitor these interfaces, deactivate or activate them (for example, after a historical load), and reconfigure them as necessary.

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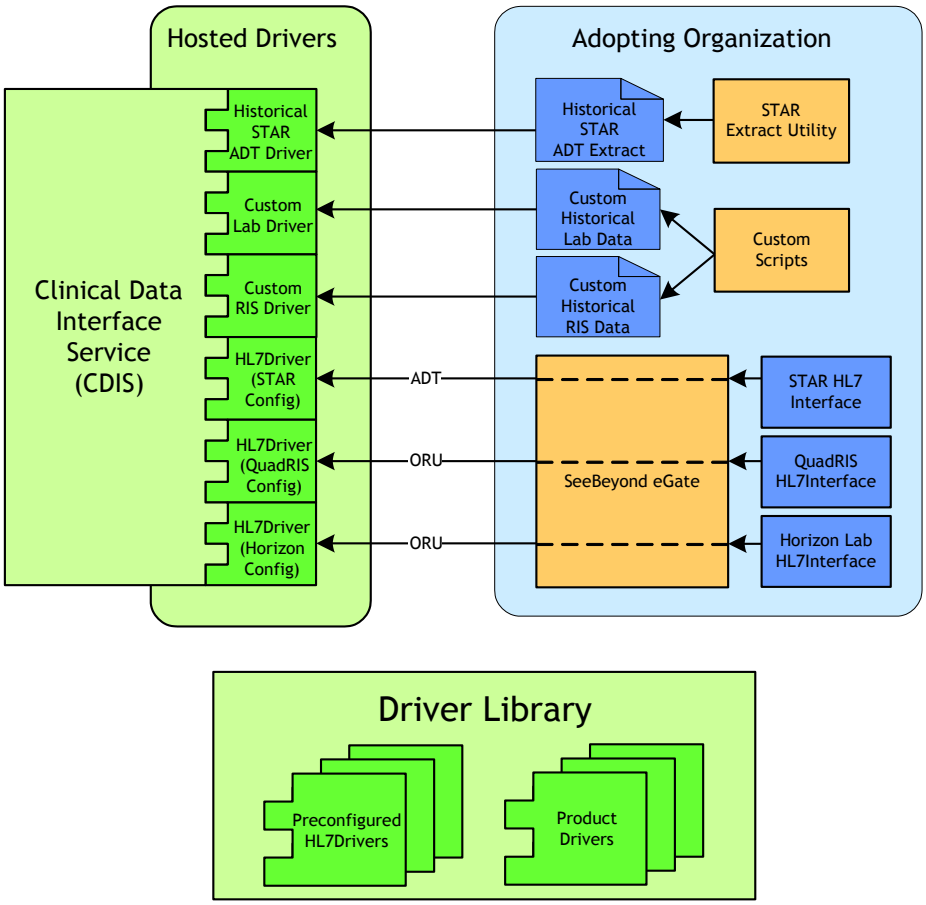
Figure 4



For example, a site with a mature IT healthcare infrastructure seeks to participate in SHARE but their EMR/HIT footprint is not IHE compliant. This facility wishes to enable data sharing with other exchange members on both historical data and live interfaces going forward. This facility has the following systems they wish to include in the initial data exchange:

- McKesson Horizon Lab System
- McKesson STAR Registration System
- ADAC QuadRIS RIS System
- SeeBeyond eGate Integration Server

The McKesson Horizon and STAR systems were integrated into the HIE Advantage where they were implemented as specific configurations of our standard HL7Driver. These configurations can be reused “out-of-the-box”. The ADAC QuadRIS system supports a well-established and well-behaved HL7Interface so this merely requires a new configuration of an HL7Driver.

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The hospital also wishes to integrate historical information from their Star, Lab and QuadRIS systems. These historical loads require some site-specific configuration. The hospital has data extract scripts for the Horizon Lab and QuadRIS systems that can be used. However, the data format these scripts output is custom and particular only to this site. Site specific drivers must be configured for this historical load. The STAR extract utility can stream historical ADT transactions to a file. The adopting hospital already has purchased a license for this product standard utility. The ADT transactions produced by the utility differ from the live HL7 feed so a product-based driver is used.

In summary, Thomson Reuters HIE Advantage has a ready set of proven pluggable drivers for the leading ADT/registration, abstraction (billing), LIS, and dictation systems for the inpatient venue. In the outpatient setting, we have completed interfaces with the leading PMIS and EMR systems. Additionally, we have robust interfaces for claims-based datasets such as UB92 and HCFA1500.

Can We Understand What We Exchange – Terminology Management

Achieving semantic interoperability between heterogeneous healthcare information systems is a challenging problem. One of the primary obstacles to interoperability is the use of independent sets of terms and codes by the participating systems. When disparate healthcare information systems refer to clinical concepts and orderable items using distinct terminologies, the data exchanged by these systems cannot be easily analyzed, compared, or rationalized for visualization.

Message exchange standards (i.e. HL7 v2.x) fail to adequately address this problem. Message standards specify the format and structure of a message so that the message recipient can fully extract all the data transmitted by the sender. However, the messages can refer to the same clinical concept using a different term or code unless a common terminology standard is also adopted.

A failure to resolve the use of independent terminologies can result in a wide range of interoperability problems. Displays using this data may be confusing and require additional effort for a care provider to understand; this may result in duplicate tests or misinformed clinical decisions. Applications that require data to be represented using a specified set of terms (i.e., a system checking drug-allergy interactions) may not function. An effective solution for healthcare information exchange must address these problems caused by the limited adoption of standard terminologies. Our innovative solution is addressed in the HIE Advantage Terminology Architecture section.

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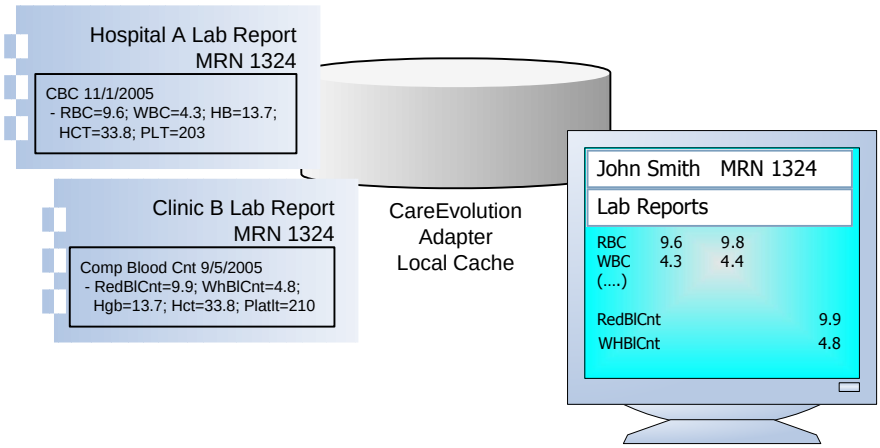
Figure 5



Lab results from disparate clinical data sources cannot be rationalized for visualization if multiple terminologies are used for test names

Recent Advances

There is broad agreement that standard terminologies should be widely adopted in order to facilitate interoperability. Several national initiatives embrace the widespread use of terminology standards in healthcare. The Office of the National Coordinator for Heath Information Technology (ONC) called for the development of technologies to facilitate deployment of a National Health Information Network (NHIN) in 2004. Proposals to develop the NHIN identify the adoption of industry standard terminologies as a critical step to achieve interoperability. To achieve this end, the Department of Health and Human Services (HHS) awarded a contract in November 2005 to the American National Standards Institute (ANSI) to create the Healthcare Information Technology Standards Panel (HITSP). The HITSP's charter is to unify existing healthcare standards in order to support interoperability among healthcare applications.

Further, the ONC has integrated the Consolidated Health Informatics (CHI) initiative into efforts to create the NHIN. CHI is a collaborative effort between the Department of Defense, the Department of Veterans Affairs, and HHS to aggressively adopt health information standards for use by all federal health agencies. As part of the CHI initiative, the agencies have agreed to endorse 20 sets of standards that enable the sharing of information across agencies and serve as a model for the private sector.

The National Library of Medicine has developed the Unified Medical Language System (UMLS) Metathesaurus in order to provide the single most comprehensive compendium of healthcare standards. It includes over 100 constituent vocabularies.

HHS signed an agreement in 2003 to license a standardized medical vocabulary developed by the College of American Pathologists for free use in the United States. The College's Systematized Nomenclature of Medicine (SNOMED) Clinical Terms creates a common clinical language that is a necessary element of a health care information infrastructure.

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Together, these initiatives create a system of standards that will facilitate interoperability. The following standards are critical to HIE development and are among the standards adopted by the CHI initiative and incorporated in the NLM's UMLS Metathesaurus:

Diagnoses	**ICD-9-CM**
Procedures	CPT-4
Text Reports	HL7 CDA
Documentation: Problem lists, Nursing	SNOMED CT
Lab Results	LOINC
Demographics, Encounters, Units	HL7
Instrument Data Exchange	IEEE 1073
Retail Pharmacy	NCPDP
Inpatient Pharmacy	NDF-RT/RxNorm

Adoption of these standard terminologies helps to solve many additional problems in healthcare. In addition to facilitating interoperability, terminology standardization can facilitate the adoption of best practices and drive evidence-based medicine. It can promote healthcare delivery efficiencies by reducing duplicate tests and procedures. Finally, it can help advance the cause of medical research by making clinical data more suitable to automated data mining techniques.

An Incremental Approach to Standardization

It is clear the wide adoption of terminology standards would greatly facilitate interoperability. However, given that several key standards are not widely adopted today, demanding adoption as a prerequisite to data integration can greatly inhibit interoperability. Any integration project that requires full adoption of standards specified by the HITSP risks bogging down in months of terminology rationalization before any data exchange can take place. While these rationalization efforts can have great long term value, clinicians will be missing critical clinical data that would drive better informed decision making in the near term. It must be accepted that voluntary standards adoption will require a massive retooling of current systems and will be an expensive, lengthy process.

Useful lessons can be drawn from existing models. The current model for the majority of medical data in the United States is a paper-based system; data is exchanged by transporting paper charts, making photocopies, and sending faxes. While there is very little terminology standardization, better decisions are clearly made when a portion of the paper chart is available. Leading researchers in information exchange such as the Regenstrief Institute also advocate the adoption of "high-value" standards that already possess a critical mass of adopters while waiting to implement other standards in the future. The Katrina Health initiative that has consolidated prescription medication information from a variety of

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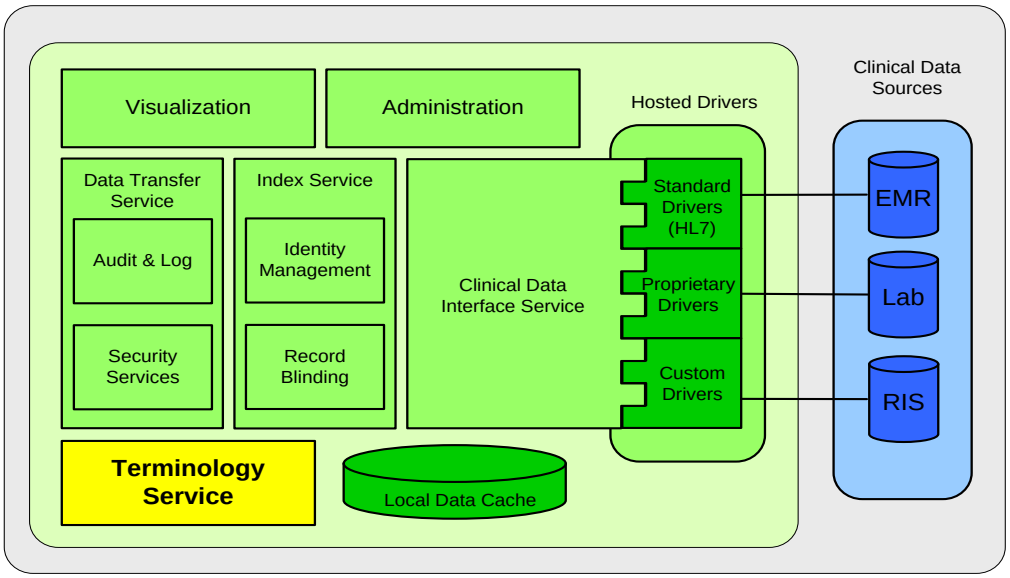
sources for patients in the Gulf Coast region is another compelling example of incremental adoption. The service has yielded great value to physicians, pharmacists and patients by making limited data available quickly even if it is not fully standardized.

Incremental adoption follows two key principles. First, efforts to deliver immediate value to clinicians should be emphasized, even at the cost of failing to completely resolve terminology challenges. Second, data exchange should proceed in a manner that is consistent with the long term adoption of national terminology standards; these terminology challenges should be resolved as standards are adopted and as resources permit. Together, these principles balance providing near term value for clinical decision makers with achieving a full featured NHIN in the long term.

The Thomson Reuters HIE Advantage Terminology Architecture

Thomson Reuters HIE Advantage provides the technical foundation to achieve interoperability while emphasizing incremental adoption of standard terminologies. Terminology management is implemented within the Terminology Service, a software module integrated within the HIE Advantage Adapter architecture.

Figure 6



The Terminology Service is tightly integrated with the Clinical Data Interface Service and the Data Transfer Service in order to provide translations to and from vocabularies supported by the UMLS Metathesaurus as clinical data moves through the HIE. A set of tools is provided to create and manage these translations.

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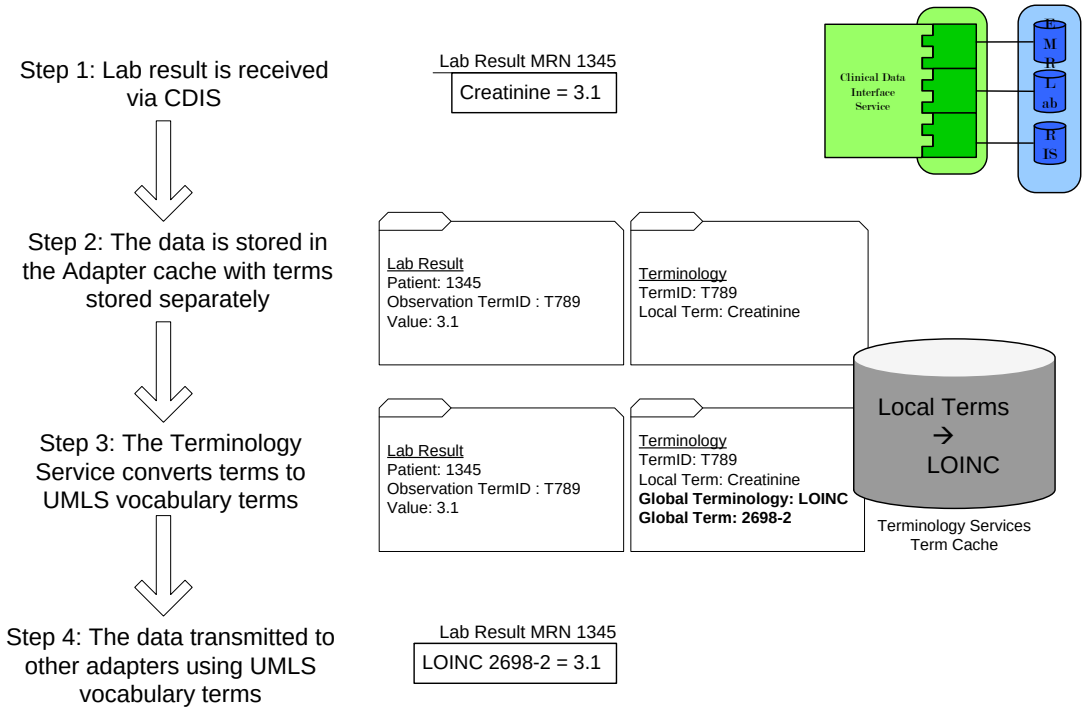
Figure 7



Local terms are translated by Terminology Services to a UMLS-Supported Vocabulary. The Terminology Service is implemented using the following design principles:

- All clinical data that is received by the HIE Advantage Adapter from a clinical data source (i.e. ADT, lab, pharmacy) is cached using terms and codes from the originating clinical system. This ensures that terminology translation will not degrade the quality of the original data.
- Any terms from a clinical data source that are not managed using a vocabulary supported by the UMLS Metathesaurus are translated to a UMLS-supported vocabulary immediately on receipt if a translation is available. This translation is cached within the HIE Advantage Adapter to ensure that clinical data can be efficiently referenced using a standard terminology during information exchange.
- Clinical data is exchanged between HIE Advantage Adapters using vocabularies that are supported by the UMLS Metathesaurus whenever possible. However, if translations to a UMLS-supported vocabulary are not available, the data will still be transmitted with terms from the originating clinical system.
- Visualization of clinical data can occur with both a UMLS-supported vocabulary and a locally supported vocabulary if a translation is available.

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- A set of tools and services provide a means to manage terminology translations. They also provide a mechanism to “retranslate” existing data cached in the HIE Advantage Adapter from previous terminologies as translations are created or standard terminologies are adopted.

Thomson Reuters Principles of Incremental Adoption

Thomson Reuters HIE Advantage provides the tools and technology services to achieve interoperability while adopting terminology standards incrementally. However, critically important to the development of a successful HIE is an effective implementation philosophy that appropriately prioritizes the adoption of different terminology standards.

The value proposition offered by terminology standardization can be assessed by considering two key dimensions of the clinical data types being considered for standardization. First, it is important to understand that different classes of clinical data exhibit a wide range of clinical value that can be derived from terminology standardization.

Standardization efforts that directly impact clinical decision making deliver significant clinical value. For example, effective clinical decision-making can be facilitated by an effective visualization of lab results that groups identical tests that are transmitted from multiple clinical data sources. Similarly, an automated system of drug-allergy interactions would reduce medical errors by evaluating allergies collected from multiple clinical data sources against medication orders. On the other hand, using a set of standard terms on a nursing assessment may not yield a significant benefit in terms of clinical decision-making or automated processing after information is exchanged. Standardization efforts should focus on clinical data where the use of standard terminologies in information exchange will deliver the greatest clinical value.

The second critical dimension of the terminology standardization value proposition is the readiness for adoption of a particular standard. Readiness for adoption can be evaluated in terms of the number of actively competing standards and the penetration of the proposed standard. If other clinical systems within the HIE do not implement a specific terminology standard (or, implement a competing terminology), it is clear that the adoption of that standard will be of limited value. Using these measures, terminology standards such as CPT and ICD-9 which are broadly accepted and widely implemented will rate very highly in terms of readiness for adoption. At the opposite end of the spectrum, relatively few clinical systems manage allergies with any sort of rigorously defined terminology; further, in practice there are several different allergy terminologies in use.

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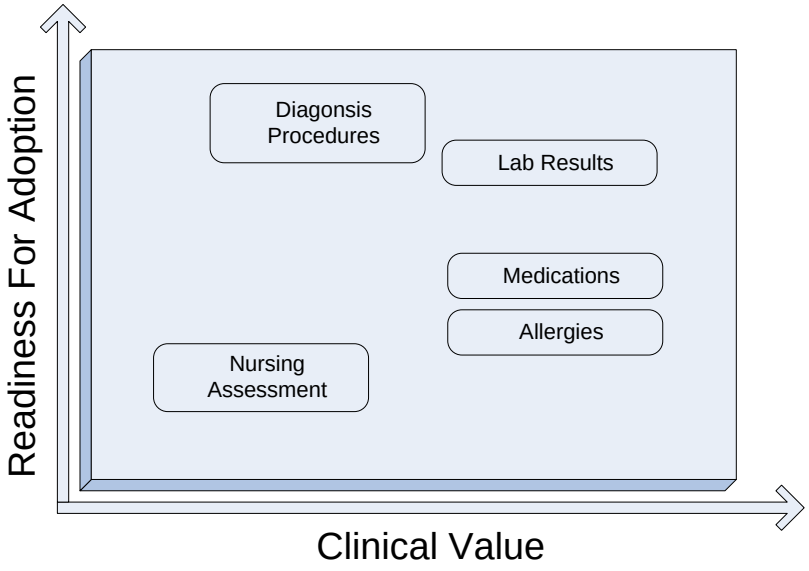
Figure 8



General Guidelines for Terminology Adoption

Clearly, each HIE will have unique considerations that drive a specific measure of clinical value and readiness for adoption for various clinical data that will be exchanged within the HIE. However, these broad guidelines provide a methodology to prioritize the adoption of various standards.

In addition to assessing the value that terminology standardization provides to information exchange, it is worthwhile to consider the impact that standardization will have to other initiatives in the clinical enterprise. Initiatives to drive more descriptive and reproducible clinical care can also derive value from terminology standardization. Additionally, implementation of best clinical practices may benefit from the adoption of terminology standards. Finally, clinical research may strongly benefit from the use of standard terms and codes. Coordinating terminology standardization with complementary initiatives can reduce the perceived cost of adoption.

2. Technical Architecture and Approach

HIE Architecture

Thomson Reuters HIE Advantage, a federated service oriented architecture (FSOA), is a comprehensive technology stack that provides solutions to rationalize patient identity, create a unified patient health record, and deliver multiple “views” (consumer, provider, researcher) of the resulting interoperable data. The following schematic shows the key components of this technology stack:

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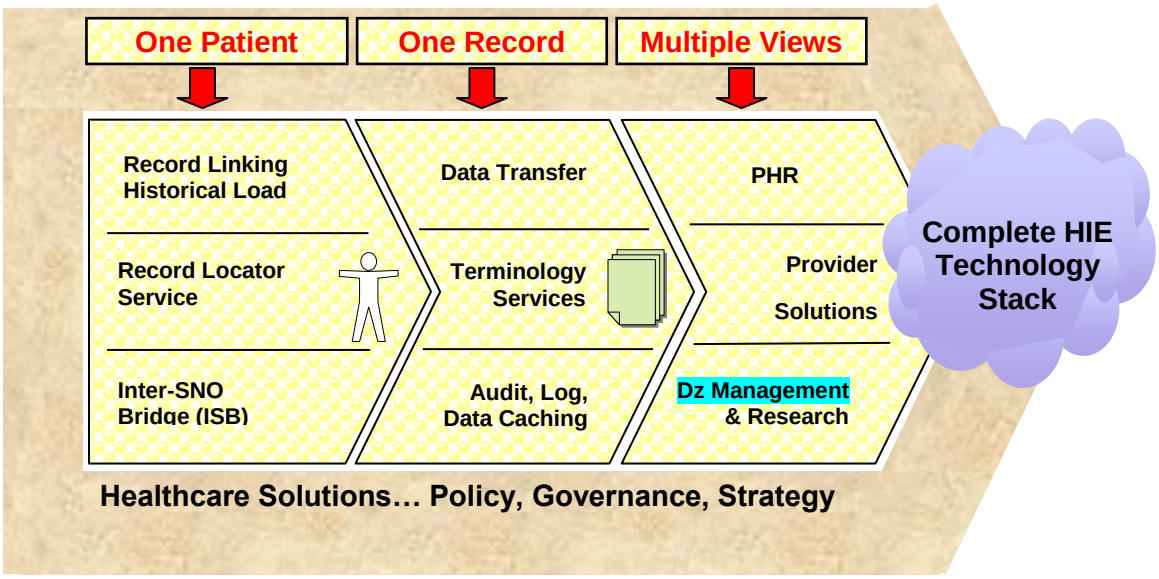
Figure 9



Thomson Reuters HIE Advantage employs a robust Service Oriented Architecture (SOA) to enable heterogeneous clinical data sources to "share" clinical information in a secure, reliable, and incremental manner. Distinct components such as Identity Management, Record Location, Clinical Data Integration, Audit & Log, Data Persistence, Visualization, Terminology, and Data Mining may be adopted piecemeal or as a comprehensive technology platform. Following the Markle Foundation's Connecting for Health Principles, Thomson Reuters HIE Advantage delivers the recommended best practices espoused by the thought leaders in the space. As active participants in the collaborative discussions amongst the various stakeholder forums nationally over the previous 48 months, our focus has been to develop the HIE Advantage from the ground-up to incorporate the consensus derived technology best practices of:

- Federation enabling Hybrid deployments
- Peer to peer data exchange
- World class identity management
- Comprehensive yet practical terminology services
- Comprehensive audit and logging services
- Service oriented architecture
- Contemporary security standards
- Granular data, patient, and provider based opt out capabilities

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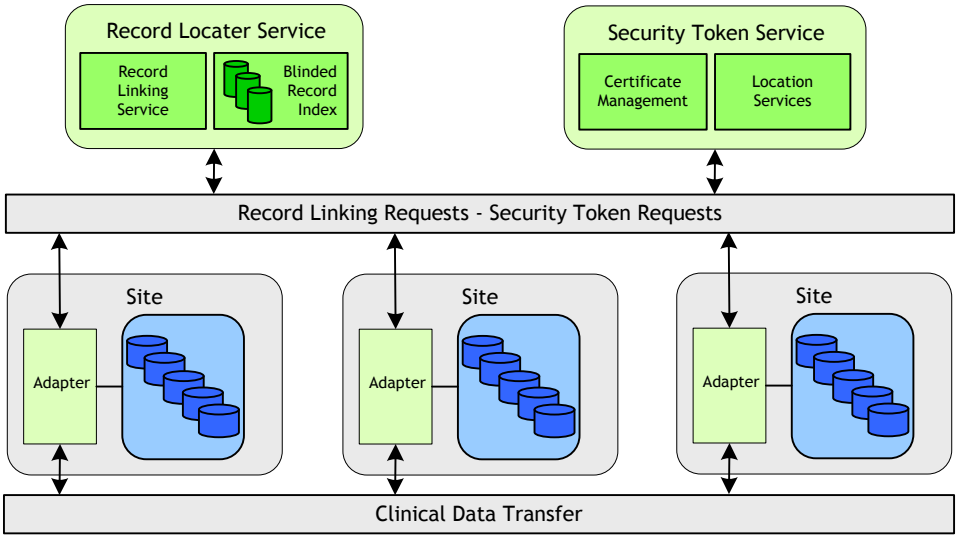
Following the world-class technology principles above, Thomson Reuters HIE Advantage is a comprehensive interoperability technology platform that enables adoption and success within the constraints experienced by real-world HIE efforts. These real-world needs have served as guiding principles to the specific platform choices and capabilities we have invested in.

Figure 10



The key components of the architecture are briefly described below.

- **Adapter** – Each participating institution (acute, sub-acute, ambulatory and other distinct organizations participating in the exchange) runs the Adapter Service that provides the interface between the Record Locator Service, peer institutions, and the institution's local clinical data sources. In essence the "adapter" is the "on-ramp" to the "little-bus" which itself is connected to the "big-bus"
- **Record Locator Service (RLS)** – The Record Locator Service (RLS) maintains an index of the locations of patient records for each person in the system. Clinical information is never sent to the RLS. Furthermore, the RLS only stores secured, blinded demographic information necessary for record linking. When a patient is registered with an institution, a query is submitted to the RLS. The RLS returns the location of any matching records. A location consists of a site identifier and a record identifier specific to the remote site.
- **Security Token Service (STS)** – The STS serves as an intermediary amongst participating members authenticating inter-member data exchange requests and insuring that no member is directly aware specifically of any other member. Adapters use the site identifier to query the STS to find the location and public key for the institution holding the desired record. Only then can peer institutions use their local record identifier to locate the linked record.
- **Peer to Peer Data Exchange (PtPE)** – Finally, the located data interchange is managed purely among the adapters at the institutions using encrypted web services. In a hosted deployment, this transaction results in a "centralized" implementation while still benefiting from the security and privacy

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safeguards of the system. This approach allows the architecture to support advanced privacy considerations for substance abuse, mental health, and other sensitive information.

CIBER Systems Integration Overview

Thomson Reuters has selected CIBER as its systems integration partner for this opportunity. CIBER is an ideal partner for the Arkansas HIE project because of its extensive experience and credentials in:

- Systems integration
- State government IT
- Healthcare IT

CIBER, Inc. is a leading international systems integrator providing superior value-priced services for both private and government sector clients. CIBER's services are offered on a project or strategic staffing basis—in both custom and package environments—and across all technology platforms, operating systems, and infrastructures.

Since 1974, CIBER has earned a reputation as a unique firm in a fast-paced marketplace. CIBER collaborates with customers to consistently and cost-effectively plan, execute, and deliver high-quality services and results. CIBER's consultants are seasoned professionals who build long-term, trusted relationships and bring a high level of energy, integrity, experience, and value to client work. In addition, CIBER has strong partnerships with best-in-class technology vendors, enabling CIBER to remain objective while working with clients to determine the most appropriate hardware, software, and services to meet their business requirements.

Based in Greenwood Village, CO, the company's consultants now serve client businesses from over 40 US offices, 25 European offices, and seven offices in Asia/Pacific. Operating in 18 countries, with more than 8500 employees and annual revenue of $1.1 billion, CIBER and its IT specialists build and implement our client's systems continuously to "competitive advantage status."

CIBER's superior customer care and the depth and breadth of services have resulted in significant repeat business with customers, collaborating with them to make optimal use of technology today while planning for the future. More than 3,000 customers—including mid-market leaders, state agencies, and many of the Fortune 500—rely on CIBER's expertise to leverage their investment in technology and guide them into the global digital economy.

CIBER's large size and many years of doing IT projects (35 years) across the public sector (state, local, and federal government) as well as the private health care sector (healthcare plans, hospitals, clinics, pharmaceutical companies, etc.) has given CIBER unprecedented levels of expertise and experience across almost all aspects of information technology related to public health.

CIBER's subject matter experts are industry thought leaders participating in industry groups, such as DAMA (Data Management Association), TDWI (The Data Warehousing Institute), and OMG (Object Management Group), and through authorship of numerous articles, white papers, and books about business intelligence, data warehousing, data governance, enterprise architecture, and other prevalent IT topics. Our Information Management personnel hold certifications in:

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- Microsoft Certified: MCTS, MCA, MCDBA, MCITP, MCDST, MSCE
- Oracle Certified Professional (OCP)
- Sun Certified: SCP, SCEA
- Six Sigma: Black Belts
- IBM Certified SOA Solution Designers

Relevant Corporate Certifications (L.9.5.c) (SOW C.6)

Our information management support is based on CIBER's CMMI Level 2 and ISO 9001:2000 management practices and is delivered by our PMP, ITIL, and Lean Six Sigma certified professionals. Our management approach is based on the CIBER Project Management Methodology (CPMM), and adheres to ITIL v3 and CMMI-DEV Level 2 processes. We are SEI appraised at a CMMI-DEV Level 3 capability for Project Planning, Project Monitoring and Control, Measurement and Analysis, Requirements Management, Configuration Management, Supplier Agreement Management, and Process and Product Quality Assurance.

The CIBER Application Process supports both incremental and iterative approaches and is compatible with Rapid Application Development. This enables CIBER to support Agile and other programming principles while adhering to the client's preferred methodology, such as the CDC's CUP/EPLC.

Company Industry Awards (L.9.5.d) (SOW C.6)

In a 2008 customer satisfaction survey, 96 percent of clients said they would unequivocally use CIBER again and 97 percent would unequivocally recommend CIBER to a colleague. CIBER has won numerous awards ranging from technical excellence to superior workplace flexibility.

Award	Description
Black Book of Outsourcing Infrastructure 2009	Rankings of various IT Infrastructure firms as compared to other Federal contractors. Our 2009 rankings include: #1 - Federal Government (Mid-Tier) #1 - Desk Top Management (Mid-Tier) #1 - Help Desk (Tier 1 & Mid-Tier) #3 - Mid-Tier Enterprise-Wide Traditional Infrastructure Outsourcing #8 - Tier 1 Enterprise-Wide Traditional Infrastructure Outsourcing #7 - Best Managed Outsourcing Vendors Globally, up from #10 in 2008
#1 KLAS Ranking - 2006	Out of 18 systems integrators in the category of Clinical and

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Award	Description
	Financial ERP Implementation for healthcare organizations.
Vault's Top 25 Technology Consulting Firms 2008	Based on surveys of 1,189 IT consulting professionals
ORACLE Platinum Partner	Highest Level in the Oracle Partner Network
Alfred P. Sloan	Highest award for workplace flexibility benefiting employees
Gartner Magic Quadrant Challenger	High Desktop and Help Desk rankings
Telly Awards 2008	Excellence in video production for training products developed for customer projects

CIBER's Corporate Awards. *The recognition of industry organizations demonstrates CIBER's focus on client satisfaction.*

Our teaming partners are also award-winning businesses with such honors as GSA Industry Partner of Excellence (A&T Systems, Inc), Washington Technology Top 8(a) Graduates (A&T Systems, Inc), and 25th Fastest Growing Private Staffing Firm in the US (Apex Systems).

Core Competencies

Application Development

CIBER delivers full lifecycle solutions by leveraging core competencies in custom Application Development in both client/server and mainframe environments, service-oriented architecture development (J2EE, .NET), managed content services, and wireless and mobility to ensure an end-to-end solution or provide application enhancements.

Enterprise Integration

CIBER designs and integrates data and applications to deliver fully functional and integrated business environments to provide a competitive advantage and maximize return on investment. Whether the State needs enterprise architecture, enterprise application integration, system integration (web services), legacy migration, business continuity/disaster recovery (BCDR), or network security, CIBER can deliver a turn-key system.

Outsourcing

CIBER manages, maintains, and enhances business applications through a variety of delivery methods to provide significant decrease in operating cost by applying standardized methodologies

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to eliminate inefficiencies and mitigate risk. Application and technical services range from application maintenance and support, application enhancement, production support, and help desk.

The CIBER competencies can be summarized into one concise message: “CIBER Builds, Integrates, and Supports systems.”

CIBER Systems Integration Experience

Hosting Services

SAS 70

CIBER’s data centers are designed and outfitted to meet the most stringent requirements and have passed rigorous SAS 70 Type II testing. CIBER will host the SHARE solution in our Staten Island Data Center.

SAS70 is not a barebones checklist audit; it is an extremely thorough audit that is used chiefly as an authoritative guidance. Type II reports are more through, because the auditors gives an opinion on how effective the controls operated under the defined period of the review. Type I only lists the controls, but Type II tests the efficacy of these controls to reasonably assure that they are working correctly.

Data Center Operations Description

CIBER is a leader in providing data center services. In September 2008, the authors of The Black Book of Outsourcing published the results from their survey of more than 400,000 business decision-makers for their data center customer experiences with more than 4,000 outsourcing vendors around the world. More than 24,000 responses were returned, audited and validated and ranked CIBER among the top ten outsourcing vendors worldwide.

The Black Book of Outsourcing survey identified the 50 best-managed global outsourcing vendors as well as identified ranking for specific capabilities within vertical industries. ***CIBER ranked first among mid-tier infrastructure vendors in ten of the 18 attributes*** surveyed for vendor overall preference/vertical industry recommendations; client relationships and cultural fit; trust; breadth of offerings, client types and delivery excellence; deployment and outsourcing implementation; customization; reliability; marginal value adds; support and customer care; and best-of-breed technology and process improvement.

CIBER’s data centers operate and deliver secure, reliable business continuity, backup and retrieval, and server hosting capabilities by deploying a “follow-the-sun” approach to data center operations. CIBER operates the data centers 24 hours a day, seven days a week in “non-stop” mode.

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CIBER is dedicated to the delivery of high quality, sustainable and scalable services to our client base. With this in mind, CIBER has built standards to govern every aspect of our operation. These standards are based on over 15 years of experience with the strategically located data centers and are continually assessed to validate their ongoing relevance and currency.

CIBER's data centers are secure, state-of-the-art facilities that provide these capabilities:

- Load-balanced, redundant Uninterruptible Power Supply (UPS)
- Two 30 ampere circuits in each equipment cabinet
- Climate control through multi-stage, air-handling units
- Diverse, routed fiber network
- Multiple T3 (45 Mbps) to Internet via UUNET & Sprint
- 24/7/365 staff
- Advanced perimeter security system monitored by ADT and Certified Protection
- 21 CFR Part 11 Compliant
- Certified SAP global hosting partner (one of five worldwide)
- AMS Certified
- ITIL / ITSM Compliance Strategy
- Change management processes
- N+1 Redundancy throughout facility
- Commercial Power, UPS & Diesel generators
- HVAC
- Pre-action sprinkler system
- FM 200 or Inergen fire suppression
- Diverse, routed fiber network
- OC3, OC12, STM-1 fiber multiplexers
- Multiple DS3 & Metro-E to Internet

CIBER is proposing Fully Managed data center services for the SHARE solution. These services are provided for customers who require full support of their computer / networked systems in the area of operational, technical and administrative support.

Fully Managed data center services includes technical support for computer servers, operating systems, database, firewall, and Internet connectivity with the addition of full responsibility of all hardware, software and firmware and all administration aspects including licensing and maintenance.

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Application, Network and Systems Monitoring

CIBER will use CA Unicenter for enterprise management of the end-to-end SHARE solution computing infrastructure with a single solution including the following:

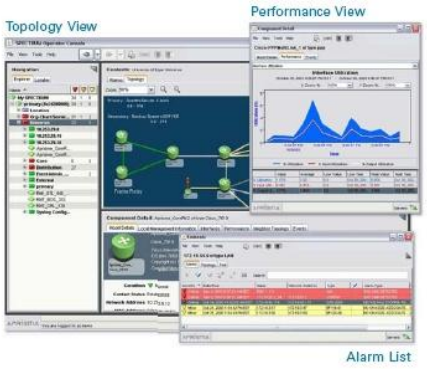
- Application Monitoring
  - Oracle / SQL Databases
  - Messaging Systems
  - Job Scheduling
  - Web Services
  - HIEBUS Application
- Network Monitoring
  - Routers
  - Switches
  - Firewalls
- Systems Monitoring
  - Operating Systems
  - Server Hardware
  - Storage
  - Backup Server and Jobs

In addition to CA Unicenter, CIBER will also use CA eHealth & SPECTRUM applications for LAN/WAN management.

CA SPECTRUM

- Faults can be prioritized based on the importance of the services that are affected

- Real-time alarms are generated, warning of service outages and impending SLA violations, including the root cause allowing them to be addressed quickly before the business is severely impacted



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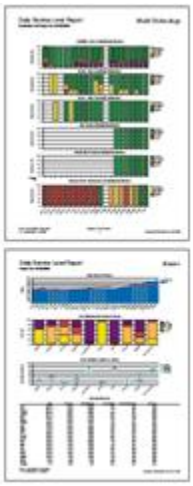
CA eHealth

- Includes real-time views into the performance and health of critical systems

- Integrate real-time content with historical performance, CIBER gains a natural workflow for identifying and resolving problems that might otherwise bring down critical systems and applications



Infrastructure Components

Platforms

CIBER is proposing an industry standard HP Proliant DL hardware platform to host the SHARE solution. Based on Intel Xeon processors technology, the Proliant DL line of servers offers the highest level of efficiency, insight and control with exceptional price-performance**.** High Speed SAN storage will be provided by EMC, the industry leader in storage technology.

The operating system platform will be based Microsoft's latest server OS, Windows Server 2008 R2. CIBER will license Windows Server to provide access to the entire SHARE solution by an unlimited number Physicians, Hospital Staff and other healthcare organizations and consumers.

The Data Base Management platform will be based on Microsoft SQL Server 2005. CIBER will implement Log Shipping with Microsoft SQL Server to facilitate the automatic backup of the production databases. Log Shipping will increase database availability by maintaining a backup server that can replace the production server quickly. Log shipping is an extremely cost effective and reliable failover mechanism. Log shipping will be in addition to daily backups listed above. This will provide an additional layer of data protection and will increase database availability.

Hardware Configuration

CIBER will host three environments; A Primary Production environment, A Log Shipping environment and a Development/Test environment. All environments will be located behind a firewall to create a protected DMZ zone for the SHARE solution.

Primary Production Environment

The primary production environment will consist of an RLS/MPI server, an Adapter Server and a Web Server. The RLS/MPI and Adapter server will be allocated 2 TB of high speed SAN storage.

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The RLS/MPI Server will be a **HP Proliant DL380 G6** with two quad core X5550 Xeon processors running at 2.66Ghz (8 core total). It will be configured with 128GB of RAM and will run Windows Server 2008 R2 Enterprise edition. Windows Server 2008 External Connector will also be installed on the server to provide unlimited end user access. SQL Server 2005 Standard edition will be installed for management of SHARE data.

The Adapter server will be a **HP Proliant DL580 G5** with four 6-core E7450 Xeon processors running at 2.4Ghz (24 core total). It will be configured with 256GB of RAM and will run Windows Server 2008 R2 Enterprise edition. Windows Server 2008 External Connector will also be installed on the server to provide unlimited end user access. SQL Server 2005 Standard edition will be installed for management of SHARE data.

The High Speed SAN storage for the RLS/MPI and Adapter Server will be provided by an **EMC Clariion CX3** SAN. 2 TB of SAN space will be allocated for these servers.

The Web Server will be a **HP Proliant DL380 G6** with two quad core X5550 Xeon processors running at 2.66Ghz (8 core total). It will be configured with 128GB of RAM and will run Windows Server 2008 R2 Enterprise edition. Windows Server 2008 External Connector will also be installed on the server to provide unlimited end user access. A SSL Certification will also be installed on the web server to provide secure internet communications.

Log Shipping Environment

The Log Shipping environment will consist of a **HP Proliant DL580 G5** server with four 6-core E7450 Xeon processors running at 2.4Ghz (24 core total). It will be configured with 128GB of RAM and will run Windows Server 2008 R2 Enterprise edition. Windows Server 2008 External Connector will also be installed on the server to provide unlimited end user access. SQL Server 2005 Standard edition will be installed to automatically receive and apply transaction logs from the production database. Storage will consist of twelve 500GB drives in a RAID 10 configuration which will yield at total of 3 terabytes of high performance usable storage.

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Development/Test Environment

The Development/Test environment will be a **HP Proliant DL380 G6** server with two quad core X5550 Xeon processors running at 2.66Ghz (8 core total). It will be configured with 36GB of RAM and will run Windows Server 2008 R2 Standard edition. SQL Server 2005 Developer edition will also run on this server.

Backup and Recovery

As noted above, CIBER will be providing a highly resilient N+1 hosting environment to withstand many types of interruption in the use of the SHARE solution which go far beyond the ability to recover data using tape backups.

N+1 redundancy is a form of resilience that ensures system availability in the event of component failure. A production component is referred to as “N” and will have at least one independent backup component referred to as “+1”. The level of resilience is referred to as active/passive configuration as backup components do not actively participate within the system during normal operation.

The following components of CIBER hosting solution will be in an R+1 configuration

- Dual Power Supplies in servers and other hardware
- Dual Network Interface Controllers and Host Bus Adapters for servers, storage devices and other equipment connected to the network
- Diesel Generator for data center power
- Redundant Uninterruptible Power Supplies (UPS)
- Redundant Cooling
- Two Internet Service providers (UUNET and Sprint)
- Raid 10 on disk drives to mirror data.
- Dual Processors in all servers
- Near real-time copy of the production data base on the Log Shipping server.

In addition to N+1 redundancy, CIBER’s hosting solution will include traditional tape backups on a daily basis and will rotate daily tapes off site. CIBER will also provide 24x7 4 hour response time with Hewlett Packard and EMC should a physical server or the SAN fail.

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3. Design Principles and Requirements

The South Carolina Health Information Exchange (SCHIEx) Draft Strategic Plan captures one of our core beliefs we hold regarding Health Information Exchange. Namely, that "erecting a healthcare data utility is analogous to the cable TV industry. No subscriber wants to pay the cable company to pull coaxial cable to their street. As consumers, our interest is in the content or channels we receive from our cable company. Investments in the infrastructure must be made by the cable company largely on the leap of faith that, once completed, the marketplace will in fact find the capabilities (channels) enabled by the infrastructure useful. Healthcare is no different. No clinic or hospital wants to pay for the work of starting from scratch and pulling cable to every other hospital or clinic – nor should they. "

The Thomson Reuters team brings this thinking in the manner in which we design our technology, market it, price it, and support it. We believe projects like SHARE need to be undertaken with this "public utility" mindset. Like any other utility, the benefits are diffuse, yet costs are highly concentrated and often front-loaded. As with our previous successes, we partner with our clients to significantly subsidize the front loaded costs to help jump-start the utility build-out. Though this procurement, like others in the industry, has a 5 year span, we model the financials and prospects over a much longer time horizon and provide a business proposition accordingly.

As we have studied this industry, as a participant and observer, and a stakeholder as a large employer, we have noted 10 best practices that guide our thinking and approach. Regardless of which particular "vendor" partner SHARE finally selects, we would recommend SHARE to be mindful of the following 10 step-program we have learnt from our practical experience in the field:

1. Obsess About Tactics Not Strategy
2. Plan for Mistakes – Ensure they are Small and Cheap
3. Avoid the Conference Room Design Trap
4. Baby Steps – Go Live with Something
5. Avoid the Empty HIE Syndrome -- Focus on Data Assets to Build Massive Provider Appeal Early in The Project.
6. Focus on Clinical Use Case First
7. Consent Policy – Say No to Opt-in
8. Caregivers Can't Drink from a Fire-Hose
9. Build Analytics into the Pipeline at Startup
10. Avoid Becoming the State EHR Provider – Focus on Exchange

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Obsess About Tactics Not Strategy

As the HIMSS HIE Best Practices Survey and the annual eHealth Initiative HIE Surveys show, there is great strategic similarities and even contracting /sourcing similarities amongst HIE efforts. Yet, in national surveys, each HIE perceives itself to be highly unique. Analysis of budgets shows that the bulk of the expense in time and money is invested in Strategy Development, Vision Formulation, and other "Strategic Planning" activities. Unfortunately, for the majority of HIE initiatives, the strategic planning struggles to turn the corner and begin a vibrant tactical rollout phase.

Statistically, most HIE projects "die on the strategy vine" because they fail to transition to production pilots. We recommend a more balanced approach where no less than 60% of the HIE resources in planning are invested in true tactical project planning to go live with a production pilot

Plan for Mistakes – Ensure they are Small and Cheap

As a follow-on corollary to the above, we find that many HIE efforts define project phases and milestones that are too big and broad. Execution risk rises and by the time the potential for "failure" is recognized, the sunk costs (credibility, monetary, time, user engagement) are too high. The efforts enter a zombie like state having "spent" the precious resources and unable to raise additional funds from "investors."

Our recommendation is to define the tactical deliverables of the project as a series of small, iterative, and concurrent phases. Focus on early and frequent pilots. In an industry where working models are few, this agile approach is critical to allow resilience from the unavoidable missteps and surprises.

"Mistakes" will be made in executing any strategy. The first key is to create a culture that expects them and learns from them rather than avoids acknowledging them. A related and necessary strategy requires that the mistakes are recognized early before the effort finds itself in the dreaded "too big to fail" mode.

Avoid the Conference Room Design Trap

Too much visioning about the future is done in too many conference rooms with catered lunches. It is hard for clinicians to participate since they are taken away from their patient care responsibilities. As a result, simple details like venue and schedule of the design sessions can have an early and repelling impact upon provider engagement. Holding design sessions and other strategic discussions embedded in hospitals and clinics before start of patient care or after can be critical in ensuring that clinician "evangelists" participate in the process.

Without the rank and file stakeholder engagement, highly detailed and technically elegant solutions are typically produced – unfortunately they rarely are accepted into production clinical use. For example, none of the NHIN I and NHIN II prototypes have succeeded in launching a production exchange. Exchanges that were operational prior to their participation in NHIN I and II continue to be active; however that is very different than the "prototypes" actually maturing to be clinically viable.

Baby Steps

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"The enemy of good is better". There are many ways to describe the insidious, seductive power of the grand design creeping its way into HIE projects. But without a deliberate guard to resist the natural "urge" of HIE teams to continually re-think and re-cast, most efforts simply never get anything "done". There is much activity and even accomplishment (plans, strategies, analyses, surveys, engagement) but just short of the finish line. We recommend that initiative define the finish line as real patient data exchanged amongst 3 distinct entities used by real caregivers.

Avoid the Empty HIE Syndrome

Typically HIE efforts struggle with the chicken or the egg syndrome: HIE's need data to attract participants but participants want the HIE to have data so they have a reason to engage. In our experience, the best model of launching an HIE is through a combination of a "broad & shallow" and "narrow but deep" data approach. Wherever possible, we anchor our initiative with a "broad but shallow" starting point by leveraging state or region-wide historical claims data (Medicaid claims, UB04, or other all-payer sources) to cover a very large patient population but with shallow depth of information for each consumer. Such datasets are ideal in early phases to erect a viable state-wide RLS/MPI and a basic continuity of care viewer reverse engineered from the claims information.

Simultaneously, we recruit provider organizations, reference labs, and prescription history sources to supplement the shallow data with these deeper clinical data assets. The resulting "network effect" provides exponential value to each incremental member but relies on a single participant to take the first step – the claims history ensures that we don't suffer from the "empty HIE" syndrome.

Whether broad/shallow or narrow/deep, HIE Advantage can be deployed in either direction, and can even handle the pursuit of both approaches concurrently. The key to this flexibility is in the consistency of the underlying adapters and exchange standards that are deployed.

Focus on the Clinical Use Case First

There are many things an HIE can and should do when it is all grown up. Consumer empowerment, research, quality reporting, biosurveillance, eligibility checking, financial transactions – the list goes on. Yet, we find that HIE efforts that don't select the Clinical Use case as their first and dominant objective struggle with a myriad of issues. First, there is no higher moral authority by which to recruit participation. Second, the effort loses the air cover provided by the "T" of TPO provisions of HIPAA creating additional policy/governance burden. In today's consumer privacy centered environment, it is harder to gain consumer trust. Finally, with the latest ONC meaningful use requirements, the bulk of the requirements are focused on the clinical use case.

Addressing the clinical use case unlocks the door to the most direct pathway to the other downstream value propositions of HIE. Other use cases can lead to a path but it is more circuitous and the visibility is poorer. It should be noted that the federal DURSA for NHIN specifically focuses on the "T" of TPO in clinical use case and at the moment specifically excludes all other use cases.

Consent Policy – Say No to Opt-in

There is no federal requirement or clarity on the prescribed consent model for HIE. That should not be interpreted to mean that all consent models are the same. National experience (most recently the reversal of consent policy by NYCLIX) shows that it is impractical to begin an HIE with a

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consent model that requires express patient consent to opt-in. If undertaken for the Clinical Use case, an amended NPP is all that is necessary to begin to operationalize the exchange.

To be clear, we strongly recommend that the SHARE follow an “opt-out” model. All consumers should be deemed to be in the exchange unless they expressly request opt-out.

Further, we recommend a federated/distributed consumer consent process operationalized at the provider participants of the AR HIE. It would be the responsibility of the participating provider to use the HIE Advantage provided web based user interface to actually opt out the consumer from the exchange. Such actions will be fully audited and transfer to all other providers participating in the AR HIE.

Further, we recommend that SHARE maintain opt-out at a “coarse” level. While the HIE Advantage technology can support highly granular data sharing policies (e.g. share my information from this primary care physician with only these other providers; or only share lab information), we recommend against implementing opt out at such granular levels.

The national experience shows that practical administration of such granular sharing policies is fraught with practical issues. Opt-out processes that discriminate on the basis of provider or facility quickly become unmanageable as the list of participating facilities evolves as it will over the 10 MRRs contemplated by SHARE. For example, let’s imagine a consumer chooses to opt-out of exchanging to a particular physician practice in May 2010. In November 2010, a new hospital joins SHARE; this physician has privileges at the new hospital. The consumer may be under the impression that the physician does not have access to their record and yet, it is quite likely that as a hospital staff member, they would gain access since the consumer did not opt-out of exchanging information with this hospital. The point here is that provider specific opt out is very difficult to administer and results in misunderstandings and loss of trust with the very consumers it is trying to protect.

Opt-out granularity based on data type is even more concerning. In our experience, such granular privacy policies and opt-out approaches lead consumers to believe that they are achieving privacy when in reality they are not. For example, a patient who wishes to restrict his or her specific diagnosis from being shared may believe that by requesting diagnosis suppression they are achieving this end; yet their medication history or a lab result may be used to infer the underlying disease state. Leading consulting organizations and think-tanks in the industry have concluded that granular opt-out while technically feasible and achievable typically fails to meet the broader functional expectations of consumers.

In this context, we recommend a conservative stance for SHARE. Any consumer with concerns regarding any aspect of the exchange should opt out fully from the exchange. Nationally, data shows that fewer than 3% of consumers actually opt-out.

In summary, we recommend that SHARE allow consumers the ability to opt-out if they declare such preference at a participating SHARE provider/covered entity. It would be the responsibility of the participating provider to use the HIE Advantage provided web based system to actually opt out the consumer from the exchange. Such actions will be fully audited and transfer to all other providers

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participating in the AR HIE. We recommend that the consumer only be provided with the choice of opting out of the entire SHARE system as a whole and not on the basis of facility, provider, or type of data.

Caregivers Can't Drink from the HIE Fire-Hose with the EMR Straws They Have

Caregivers are already overwhelmed with the amount of "data" they have to contend with. In this environment, delivering even more information from many more sources is a recipe for disappointment. As a physician leader testified at the NHIN meetings, "I already have too much data to wade through. Throwing more at me just increases my legal risk and slows me down."

Traditional episode of care based viewers (all current EMR and most HIE viewer products) simply divide a summary screen into 4-6 groups showing reverse chronological lists of diagnoses, procedures, medications, providers, lab and the like. While this may be acceptable to review what happened to a patient over the last day or week, this man-machine interface fails completely to deliver a continuity of care view highlighting the health history of the patient over the previous year or two.

We urge SHARE to carefully evaluate the web based "viewers" from the perspective of how they will help caregivers consume years of information aggregated from dozens of providers. For the 20% of patients with chronic disease consuming 80% of health care resources, these traditional approaches completely fail to meet the needs of the clinicians.

Advanced human factors engineering in the viewers as front ends to lifetime clinical histories is necessary to prevent the late stage disappointment. You build the HIE. You get data flowing through it. You customer can't consume it.

Build Analytics into the Pipeline at Startup

With the focus on meaningful use and quality reporting, in 2010 an HIE has to do much more than "messaging". Systems designed to simply deliver content from one end to another do not scale well to perform more sophisticated functions that require analytic readiness. There is no way to escape the GIGO principle (Garbage-in-Garbage-out) if each end is trying to perform its own translations. Analytic readiness and data transformation must be conducted as the data moves through the pipes so that each edge system does not have to embed intelligence – it is prohibitively expensive to fix data at the receiving edge.

This recognition was the driving force precipitating the fusion between CareEvolution and Thomson Reuters. We have undergirded an HIE platform with the ability to link clinical and administrative data, apply data standardization that enables analytical readiness, select specific clinical and administrative data fields for a centralized decision support database, and develop reliable measures for evaluating and demonstrating meaningful use, measuring quality outcomes, and validating cost savings. Only with such foundational capabilities can SHARE effectively mine retrospective data to apply evidence-based guidelines and identifying care practices that can be improved to increase quality and safety. These findings can be inserted back into the HIE and then embedded into point of care systems to support decision making between providers, clinicians and patients

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Avoid Becoming the State EHR Provider – Develop an Exchange Competency

It is understandable that many State Designated Entities (SDEs) find themselves wanting to be "one-stop-shops" for providers trying to achieve meaningful use. It is what the users "want". However we believe responding to this "want" is counterproductive to the ONC expected mission. It is challenging enough to just succeed with exchange – adding the responsibilities for EHR and education confuses the mission and dilutes the initiative. Further, we are beginning to see perverse effects where SDE efforts to be EHR providers are competing with Hospital/IDN efforts to provide sponsored EHRs to their referring physicians. In the last 3 months we have noticed an increased tension between provider stakeholders and those SDEs that plan to offer EHRs as the hospitals stakeholders view them as "competition". This is a very destructive dynamic since the SDE HIE needs the hospitals as the anchor participants in the exchange.

Health Information Exchange is Job One for State Designated Entities. In fact, the ONC HIE Cooperative Agreement funds may not be spent on activities unrelated to exchange. Certainly, the funds may not be used to host and provide EHR functionality that enables providers to qualify for their EHR Meaningful Use Incentive Payments. While concerns about 3 year out sustainability lead HIE organizations down the path of EHR service provision, it compromises immediate ability to focus. It is our concern that this diffusion of effort and energy materially increases the potential for execution failure on the part of most HIE organizations.

4. Architectural Overview

Thomson Reuters HIE Advantage employs a robust Service Oriented Architecture (SOA) to enable heterogeneous clinical data sources to "share" clinical information in a secure, reliable, and incremental manner. Distinct components such as Identity Management, Record Location, Clinical Data Integration, Audit & Log, Data Persistence, Visualization, Terminology, and Data Mining may be adopted piecemeal or as a comprehensive technology platform. Following the Markle Foundation's Connecting for Health Principles (adopted by the NHIN), Thomson Reuters HIE Advantage delivers the recommended best practices espoused by the thought leaders in the space. As active participants in the collaborative discussions amongst the various stakeholder forums nationally over the previous 6 years, our focus has been to develop the HIE Advantage from the ground-up to incorporate the consensus derived technology best practices of:

- Federation-enabling Hybrid deployments
- Peer-to-peer data exchange
- World class identity management
- Comprehensive yet practical terminology services
- Comprehensive audit and logging services
- Service oriented architecture
- Contemporary security standards
- Granular data, patient, and provider based opt out capabilities

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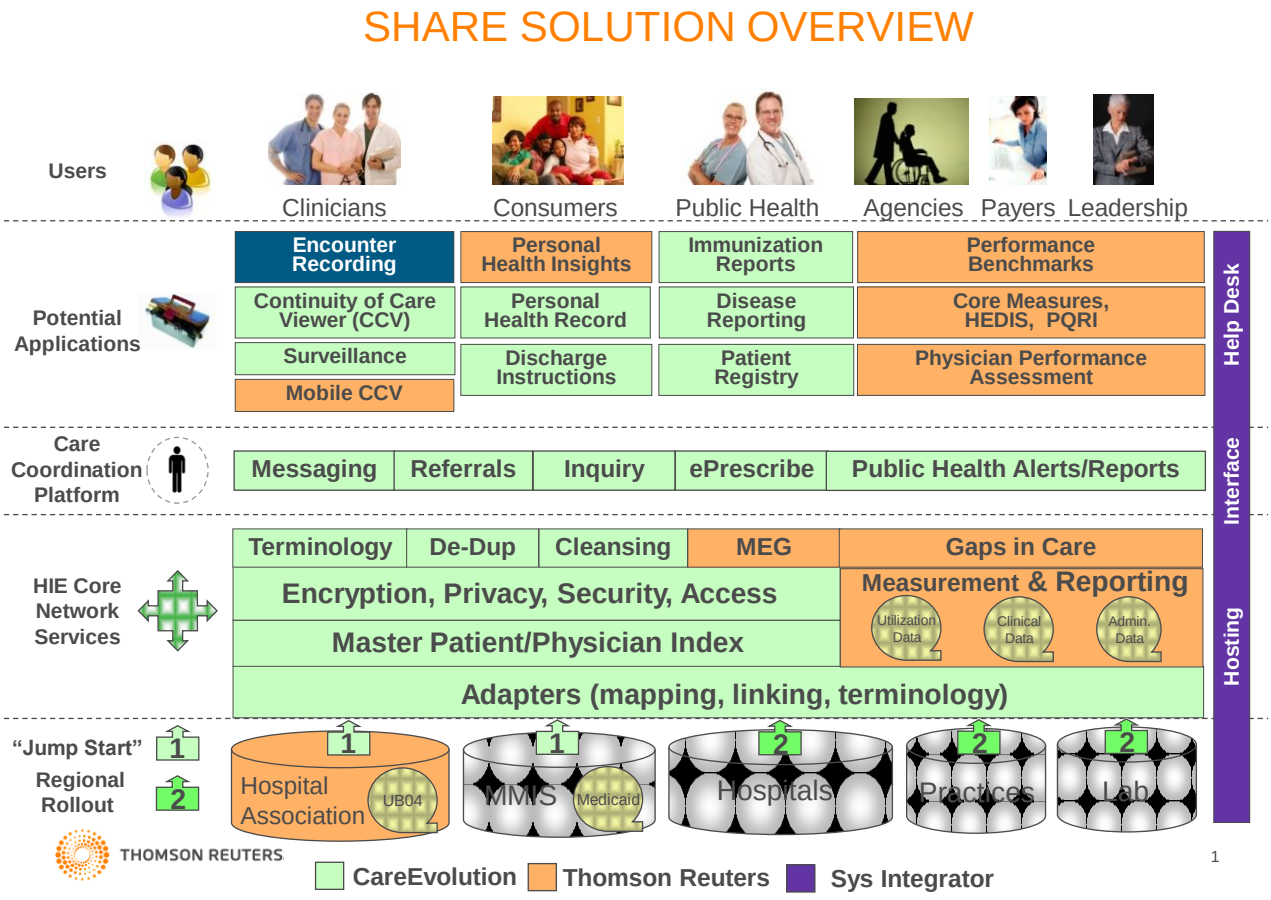
- Robust Applications: Hosted applications such as ePrescribing, a thinEMR viewer enabling providers with or without existing healthcare IT solutions to leverage the exchange, and public health reporting capabilities are available out of the box on the core HIE architecture.

Figure 11



As an overview for our complete solution, **Figure 11** above depicts how Thomson Reuters and its sub-contractors will align our capabilities to meet SHARE's unique requirements. The chart depicts four layers of functionality that will build increasing levels of interoperability, adoption and value for target user groups as they are phased in through our proposed implementation plan.

Technical Architecture

This block diagram in provides a high level view of the Advantage HIE design; a service oriented architecture (SOA) technology stack that provides comprehensive but modular tools to deploy and operate a health information exchange. Advantage HIE layers can be implemented in hybrid (federated/centralized) deployment models to best meet the specific needs to rationalize patient

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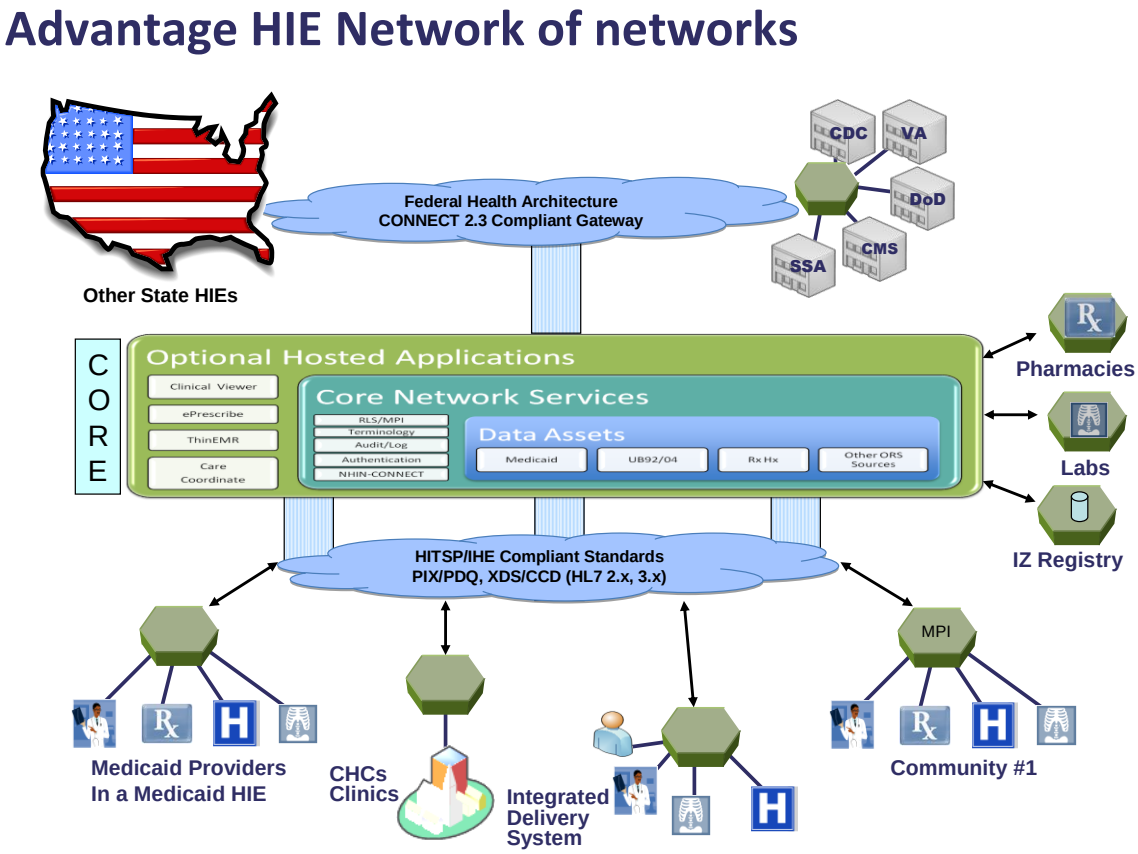
identity, create a unified patient health record, and deliver multiple "views" (consumer, provider, researcher) of the resulting interoperable data.

Figure 12



Since the Advantage HIE RLS supports the Inter SNO Bridge design from Markle and IHE PIX/PDQ, this design is able to fully support a loosely distributed model where there are actually multiple RLS coexisting, even from multiple MPI vendors. This capability is critical in participating with adjacent states and the NHIN. We are actively working with the Federal Health Architecture CONNECT 2.2 SDK to support inter-HIE and state to federal systems connectivity using the CONNECT platform. Key items of note in this architecture are its flexibility and compliance with emerging standards:

- Advantage HIE supports a federated model where the edge system Adapters are physically located adjacent the source. For example the Hospital 1 adapter could be located in the data center at the hospital. It would communicate via encrypted traffic to the RLS located at the data center over the internet.
- System can accommodate a physically centralized model by physically implementing each adapter at a single hosted site. We propose a hosted solution whereby all the federated adapters will actually be physically housed in a single data center. This

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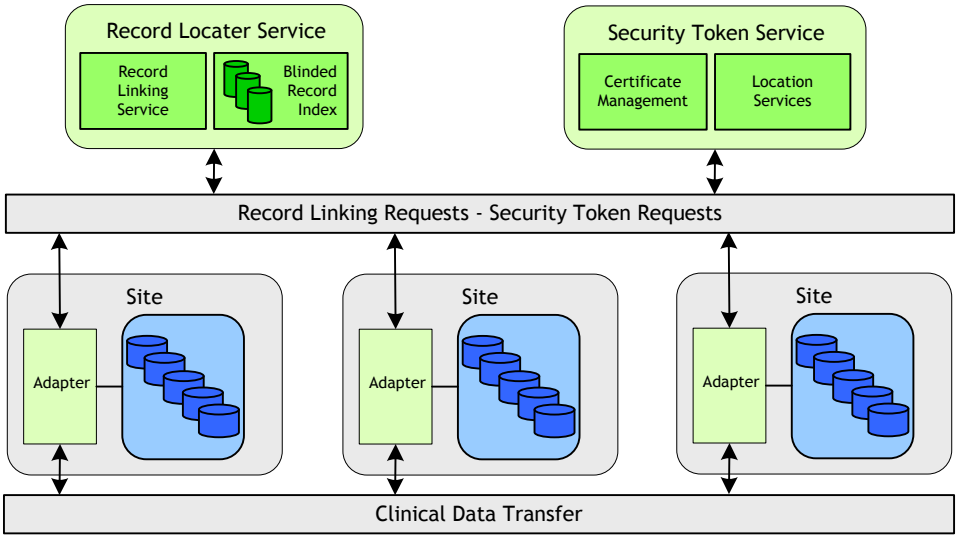
affords SHARE the best of both worlds: complete privacy/security while leveraging economies of scale of centralized hosting

- A record locator service (RLS) serves as the central switchboard for all systems and consumer transactions
- There is no centralized aggregate store of decipherable PHI information. Anonymization is strongly enforced. Reidentifying data requires the aggregate store to submit an authorized request back to contributing site of the data.
- Optionally, non PHI/anonymized data can be aggregated centrally as a feeder to the advanced business intelligence tools to support population health, research, biosurveillance and predictive modeling applications.

Figure 13



The key components of the architecture are briefly described below.

- **Adapter:** Each participating institution (acute, sub-acute, ambulatory and other distinct organizations participating in the exchange) runs the Adapter Service that provides the interface between the Record Locator Service, peer institutions, and the institution's local clinical data sources. In essence, the "adapter" is the "on-ramp" to the "little-bus" which itself is connected to the "big-bus."
- **Record Locator Service (RLS):** The RLS is a standards compliant SOA implementation of an enterprise master patient index. Clinical information is never sent to the RLS. Furthermore, the RLS only stores secured, blinded demographic information necessary for record linking. When a patient is registered with an institution, a query is submitted to the RLS. The RLS returns the location of any

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matching records. A location consists of a site identifier and a record identifier specific to the remote site.

- **Security Token Service (STS):** Using industry standard (WS*) certificates, the STS serves as an intermediary amongst participating members authenticating inter-member data exchange requests and insuring that no member is directly aware specifically of any other member. Adapters use the site identifier to query the STS to find the location and public key for the institution holding the desired record. Only then can peer institutions use their local record identifier to locate the linked record.

- **Peer-to-Peer Data Exchange (PtPE):** Finally, the located data interchange is managed purely among the adapters at the institutions (hosted centrally in this proposed SHARE design) using encrypted web services. In a hosted deployment, this transaction results in a "centralized" implementation while still benefiting from the security and privacy safeguards of the system. This approach allows the architecture to support advanced privacy considerations for substance abuse, mental health, and other sensitive information.

Applicability to SHARE Requirements

HIE Advantage provides a flexible and scalable technology platform for HIE deployment. It is a federated service oriented architecture that connects fragmented clinical and administrative data to deliver a unified, integrated, and analytically ready view of patient's entire care continuum. Purpose specific anonymized and sanctioned (public health reporting use case) aggregated data repositories can be created that supports the creation of meaningful use measures, quality and compliance reporting, and analytical and reporting services.

This hybrid approach is ideal for accommodating a variety of SHARE's phased objectives, ranging from Phase 1 requirements for establishing the statewide backbone, to Phase 2 requirements for integrating more private stakeholders. The key components of our HIE Advantage include:

- An advanced, highly secure **Record Locator Service** and **Master Patient Index** (RLS/MPI) that provides standardized linkage in the distributed system by using a blinded directory for centralized demographic data. A set of security techniques are implemented to cryptographically (one-way) hash the aggregated data to ensure that patient demographic data stored in the centralized index is unrecoverable. Thomson Reuters is a recognized expert in the field of record linking (RL) given its 20+ year track record is performing this function for various federal agencies.

- **Adapters** that are tailored to each clinical and administrative data source and serve as the "on-ramp" to the central backbone. Each Adapter is composed of a comprehensive stack of data services that enable interoperability and establish data standards through the network.

  - **Record Index Service –** Provides the interface between the host systems and the Record Locator Service. It standardizes and blinds demographic information before sending requests to the Record Locator Service.

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- **Data Transfer Service** – Manages adapter to adapter communication of clinical information. This is managed in pure peer-to-peer fashion.
- **Clinical Data Interface Service (CDIS)** – Hosts a set of pluggable drivers for communication with an institution's local clinical data sources such as EMR, lab, or pharmacy systems. The CDIS allows for easy customization to support the disparate clinical data sources of each institution. Each driver may run in one or more threads or processes dependent on the available hardware and required workload.
- **Terminology Service** – Used by the Data Transfer Service and CDIS to provide translation between local (legacy) and standardized nomenclatures.
- **Local Data Cache** – If needed, the Adapter provides a data store in which both record location index information and clinical information is cached. The Local Data Cache may be a single physical DBMS or can be federated across multiple physical databases.

- A comprehensive **Care Coordination Platform** that supports and facilitates a wide range of daily care functions, including patient inquiry, messaging, referrals, and ePrescribe. Additionally, supported by centralized reporting functions, the Care Coordination Platform can produce public health alerts and reports, including feeds for immunization and disease reporting, or maintenance of a patient registry
- A **Continuity of Care Viewer** that provides a real time summary of patient data from across many sources of care, for use by their clinicians and other authorized care givers to facilitate and improve real-time clinical decision making. The summarization of longitudinal, clinical data can be daunting, especially for patients with co-morbidities or complex chronic conditions. By applying Thomson Reuters Medical Episode Grouping methodologies, complex, longitudinal patient data can be grouped and condensed into more actionable and meaningful data displays. Additionally, advanced Micromedex drug-to-drug alerts and reference data are embedded to provide real-time access to best practice information that reduces safety errors and increases quality outcomes. Micromedex saves clinicians valuable time and helps them ensure their patients' needs are taken care of promptly and safely by providing answers to the most complex clinical questions related to DrugDex/DrugPoints, drug interactions, IV screening, drug comparison, drug ID, DiseaseDex/ClinicalPoints/Clinical Checklist, patient education, and laboratory test information.
- A **Centralized Decision Support Database** of select clinical and administrative data can be continually updated and refreshed to monitor the overall clinical and financial performance of the network, and to enable analytics and reporting within and across Community HIEs. We envision this repository can also serve as a means of measuring meaningful use throughout the state in terms of quality and efficiency, in addition to deriving best practice norms across the network.

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- A **Personal Health Insights Portal** that can function either as a "medical home" to augment patient/physician interaction, or as a reference center that provides each citizen a place to view their personal data in the network, access transparency data on healthcare quality and cost throughout the State, and personalized decision support for wellness, disease management, and chronic disease management.
- **Advanced Applications** like Surescripts certified ePrescribe and a Web-based ThinEMR that allows for encounter recording and care coordination.

5. Core Requirements

As per the RFI for an HIE for the state of Arkansas, SHARE's HIE core requirements are as follows:

Master Patient Index (MPI)

While there are many important considerations in a HIE network, determining the appropriate system architecture for patient identity location is the first and most crucial step in building an effective and secure healthcare data exchange solution. A Record Locator Service (RLS) is the actor in an HIE network that determines which patients have records at multiple institutions and therefore where clinical information may be located.

Everyone agrees that an effective community Master Patient Index (MPI) is a critical pre-requisite to an effective HIE. However, just as organizations have struggled with effective implementation and integration of an MPI solution within their facilities, there have been significant challenges in implementing an MPI across the community (better known as the RLS).

An RLS has all of the complexities of an MPI solution: it must first ensure that a given institution's patient database is free of duplicates or to identify those duplicates. It must then communicate with the network to find matching records from every other institution. Similar to an MPI, the RLS record linking must be optimized for near-100% specificity to prevent the possibility of incorrectly associating clinical data with patients. An RLS also has all the complexities of a general purpose record linking product in that it must have acceptably high sensitivity to find the appropriate records at each site, and to automate the linking process to keep system maintenance costs low. Finally, Record Location Services must be secure as the information flowing though them is highly sensitive.

CryptoRLS™, a core component of HIE Advantage, meets the community MPI challenge by delivering the following:

- **Zero Tolerance:** There must be a near-zero false positive link rate. The worst case scenario for a HIE record linking system is to incorrectly link patients and move or display data on the wrong patient record. South Carolina has used CrytoRLS to

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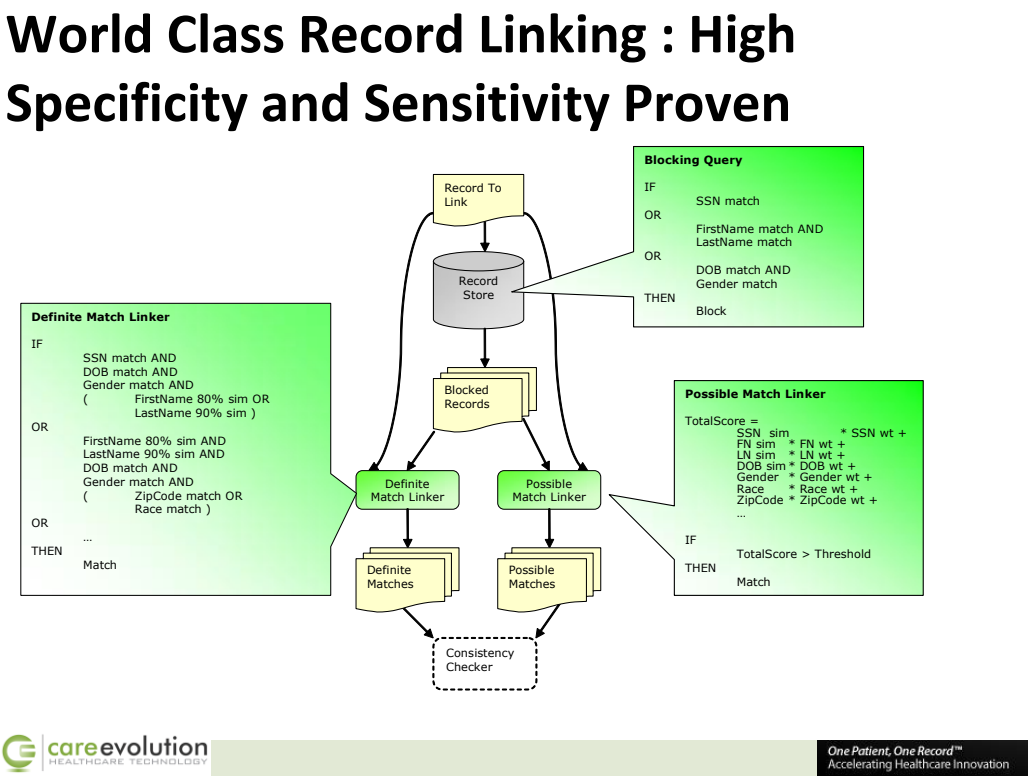
manage over 6.1 million consumers and has audited the record linking algorithms to near 100% specificity to prevent false positives.

- **Automated:** The platform should leverage record linking techniques that can perform the vast majority of the linking activity without human intervention. However, in the case of possible matches, where manual review is appropriate HIE Advantage provides a streamlined web based user interface so that medical records and registration clerk and other administrators can quickly review and accept links.
- **Real-time:** The system should perform in near real-time so that clinically relevant information from remote institutions can be incorporated in existing workflows.
- **Proven algorithms:** CryptoRLS has been successfully deployed within South Carolina by the Office of Research and Statistics (OR&S) to link over 10 years of UB92 and Medicaid information on over 6 million distinct consumers. OR&S selected CryptoRLS after benchmarking data against existing linking strategies showed that CryptoRLS delivered higher specificity and sensitivity.

CryptoRLS achieves its world class performance by leveraging the work done by the US Bureau of Census and the SAMSHA (Substance Abuse and Mental Health Agency) which arguably have the deepest global experience in record linking using probabilistic linking techniques.

Figure 14



careevolution HEALTHCARE TECHNOLOGY — One Patient, One Record™ Accelerating Healthcare Innovation

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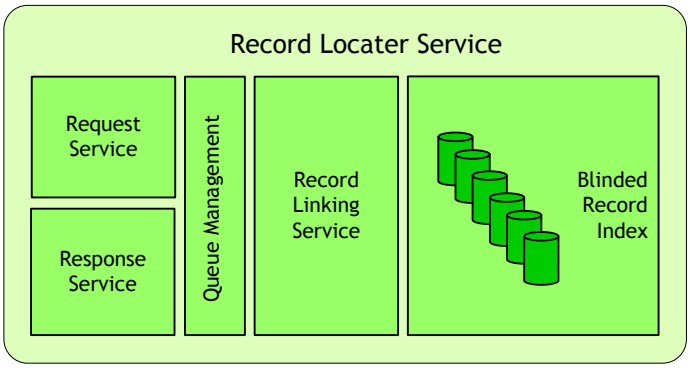
The Bank Safety Deposit Box Model

The proposed RLS will be built on CryptoRLS to provide an unprecedented privacy guarantee over any two-way encryption or basic anonymization scheme because the underlying data cannot be decoded – even by the operators of the HIE itself. Just as the bank provides a service for managing valuables in the safety deposit box without having access to the contents, with CryptoRLS CCITI can implement an RLS without having any centralized access to the member records. Re-identification can only be performed by adjudicating the blinded key for a given consumer from the actual contributor of the data – the actual contributing members of the CCITI. In summary, anonymization is guaranteed using one-way hashing techniques (developed at the NSA) while re-identity is possible only by requesting patient identity from the contributing provider/data organization.

Figure 15



The Record Locator Service (RLS) provides the functions necessary for patient linking and indexing. The Request Service, Response Service, and Queue Management Services manage the communications infrastructure between the RLS and client adapters.

- **Request Service:** The Request Service exposes the Web service interface to receive asynchronous record add and update requests. The requests are queued for record linking.
- **Response and Queue Services:** The Response Service manages the communication of the results of record linking operations to the originating adapters for the linked records. Like all CareEvolution components the Request Service, the Response Service, and the Queue Management Service can be hosted with one instance of each on a single machine, multiple threads for each process on a single machine, or multiple processes on multiple machines. The required configuration is dependent on the traffic serviced by the RLS.
- **Blinded Record Linking Service:** The core work of the RLS, the actual record linking, is performed by the Blinded Record Linking Service. The Blinded Record Linking Service implements an incremental probabilistic matching algorithm to link each record added to the Blinded Record Index with the existing records in the index. Multiple instances of the Blinded Record Index Service can be used.

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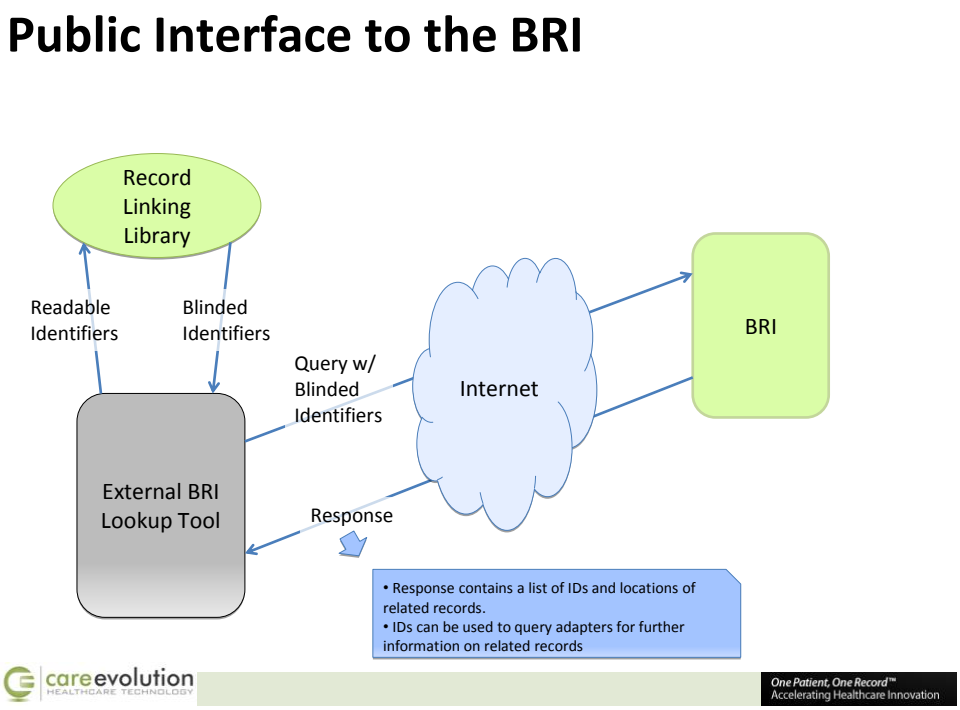
The Blinded Record Index data store is implemented as a federation of databases with each node of the index storing a subset of the records. This allows record linking to be done in parallel across disjoint subsets of the records in the index. As the size of the record index grows additional nodes can be added to the federation allowing the index to expand.

Figure 16



Data Dictionary and Vocabulary Standardization

Thomson Reuters HIE Advantage provides the tools and technology services to achieve interoperability while adopting terminology standards incrementally. However, critically important to the development of a successful HIE is an effective implementation philosophy that appropriately prioritizes the adoption of different terminology standards.

The value proposition offered by terminology standardization can be assessed by considering two key dimensions of the clinical data types being considered for standardization. First, it is important to understand that different classes of clinical data exhibit a wide range of clinical value that can be derived from terminology standardization.

Standardization efforts that directly impact clinical decision making deliver significant clinical value. For example, effective clinical decision-making can be facilitated by an effective visualization of lab results that groups identical tests that are transmitted from multiple clinical data sources. Similarly, an automated system of drug-allergy interactions would reduce medical errors by evaluating allergies collected from multiple clinical data sources against medication orders. On the other hand, using a set of standard terms on a nursing assessment may not yield a significant benefit in terms of clinical

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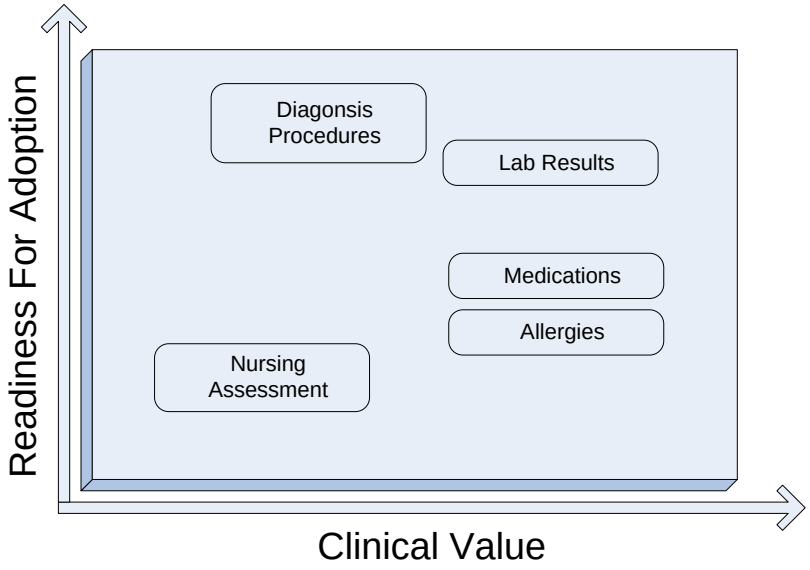
decision-making or automated processing after information is exchanged. Standardization efforts should focus on clinical data where the use of standard terminologies in information exchange will deliver the greatest clinical value.

The second critical dimension of the terminology standardization value proposition is the readiness for adoption of a particular standard. Readiness for adoption can be evaluated in terms of the number of actively competing standards and the penetration of the proposed standard. If other clinical systems within the HIE do not implement a specific terminology standard (or, implement a competing terminology), it is clear that the adoption of that standard will be of limited value. Using these measures, terminology standards such as CPT and ICD-9 which are broadly accepted and widely implemented will rate very highly in terms of readiness for adoption. At the opposite end of the spectrum, relatively few clinical systems manage allergies with any sort of rigorously defined terminology; further, in practice there are several different allergy terminologies in use.

Figure 17



General Guidelines for Terminology Adoption

Clearly, each HIE will have unique considerations that drive a specific measure of clinical value and readiness for adoption for various clinical data that will be exchanged within the HIE. However, these broad guidelines provide a methodology to prioritize the adoption of various standards.

In addition to assessing the value that terminology standardization provides to information exchange, it is worthwhile to consider the impact that standardization will have to other initiatives in the clinical enterprise. Initiatives to drive more descriptive and reproducible clinical care can also derive value from terminology standardization. Additionally, implementation of best clinical practices may benefit from the adoption of terminology standards. Finally, clinical research may strongly benefit from the use of standard terms and codes. Coordinating terminology standardization with complementary initiatives can reduce the perceived cost of adoption.

Provider Index and Directory

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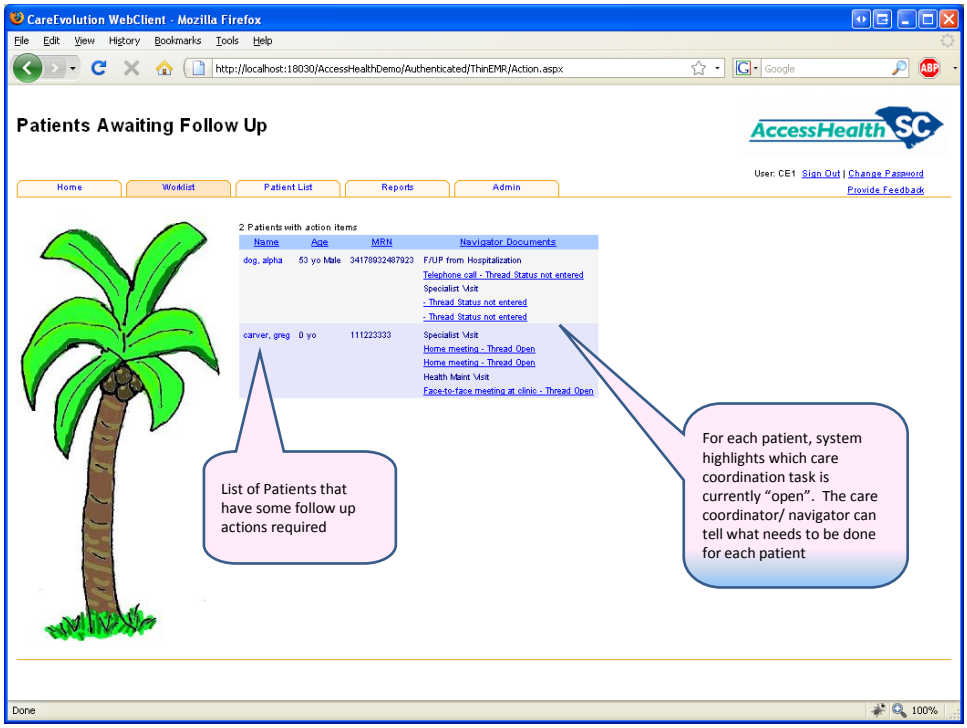
The Care Coordination Platform supports complete referral generation, receipt and follow up amongst health care providers. This Web-based application also supports participation by patient navigators to help manage transitions of care between health care providers. We invite SHARE to review the attached user documentation of the CCC – Connecting Communities of Care in Attachment 7 showing this basic functionality as well as advanced encounter recording integrated with the referral and inquiry functionality described below.

The rich ability of the system to enable care coordination significantly aids practices in complying with NTOCC and PCMH requirements. In fact, we are one of only 6 HRSA Patient Navigation pilots in the country with AccessNET in South Carolina. Screenshots of the AccessNET branded CareCoordinate™ platform are provided to share the depth of functionality offered by the platform.

Figures 18



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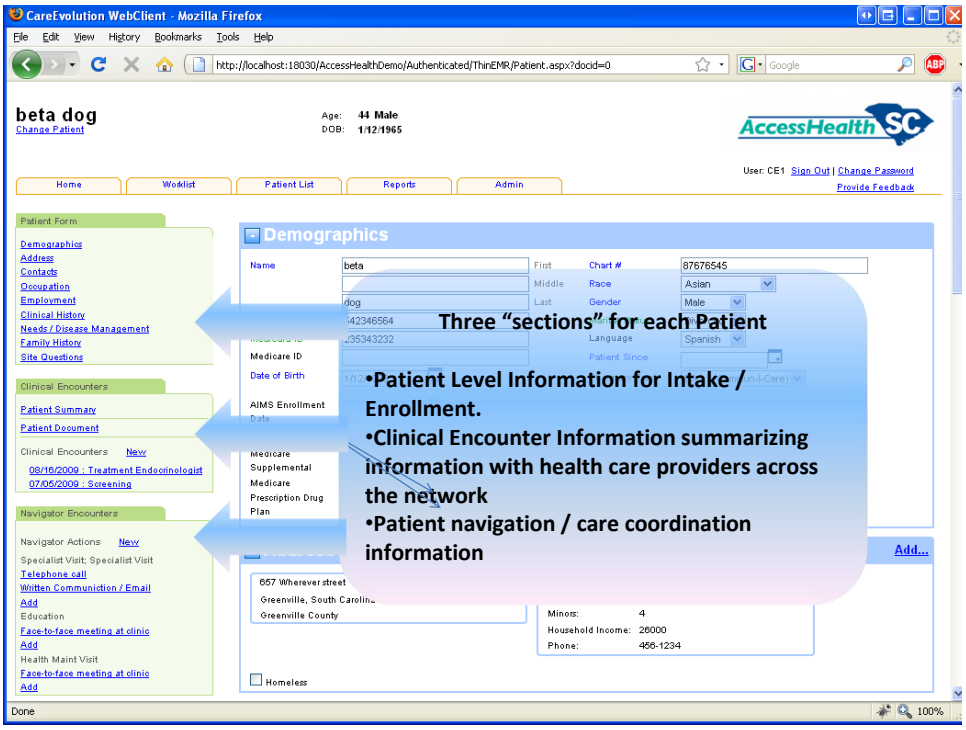

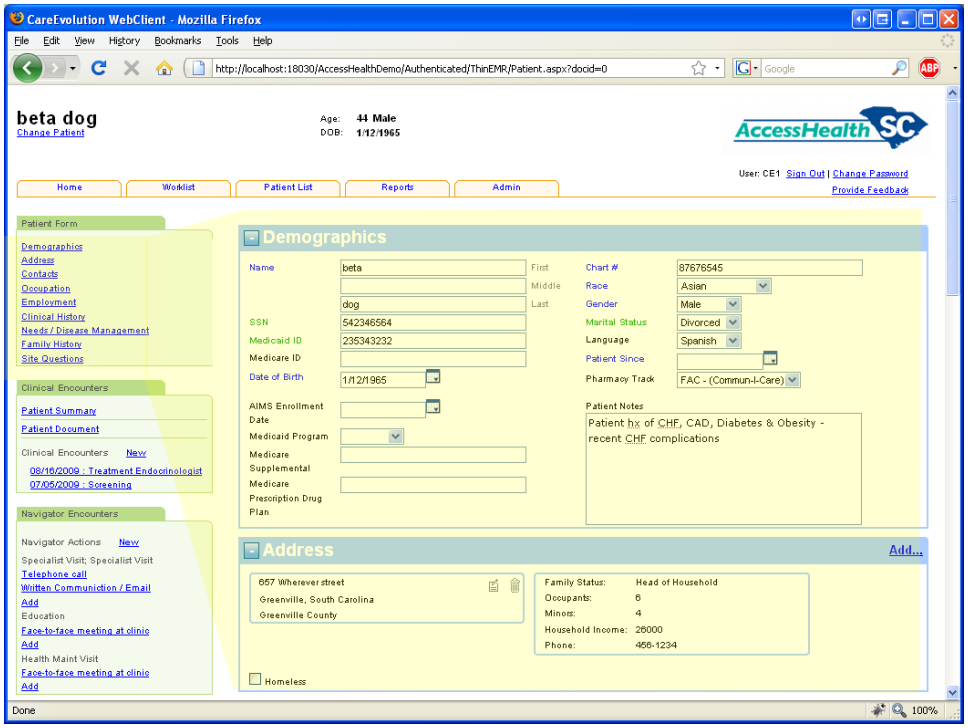

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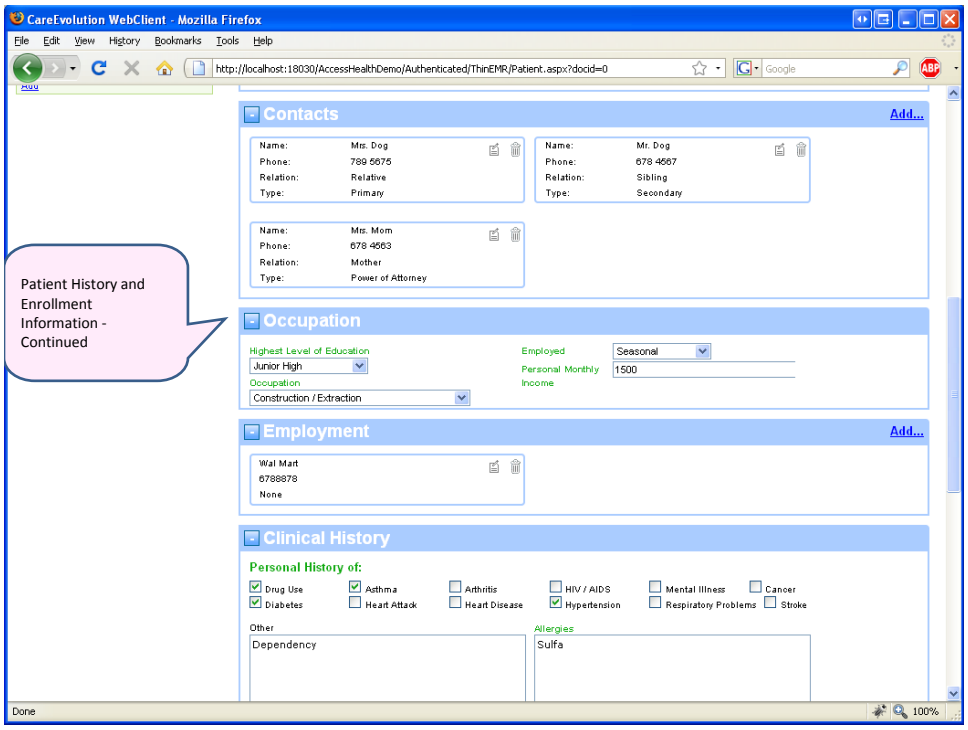

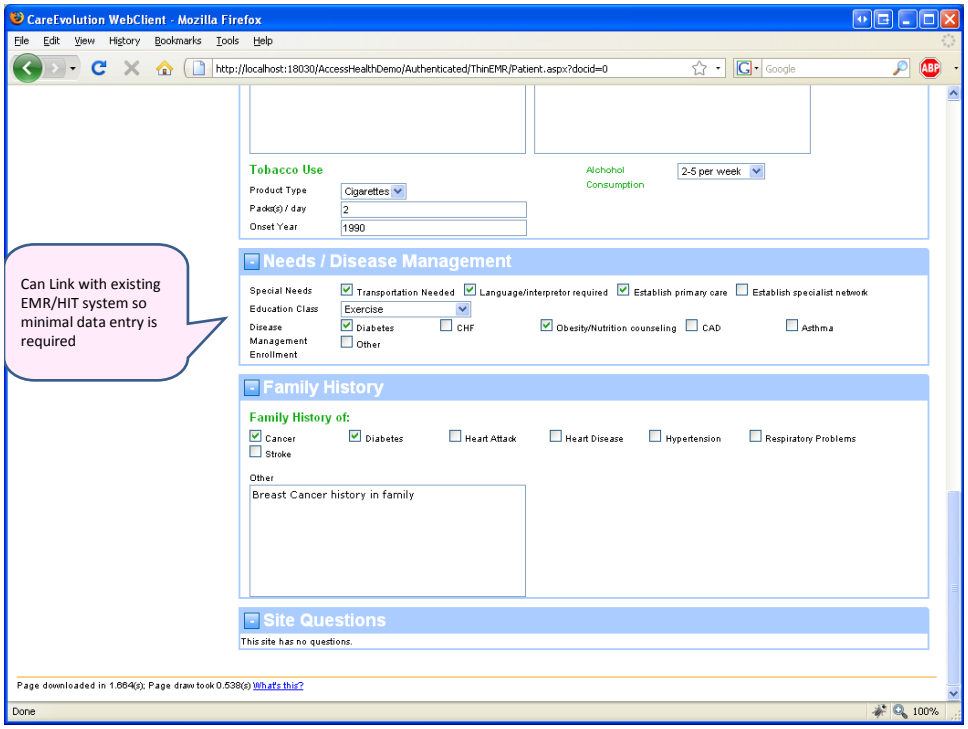

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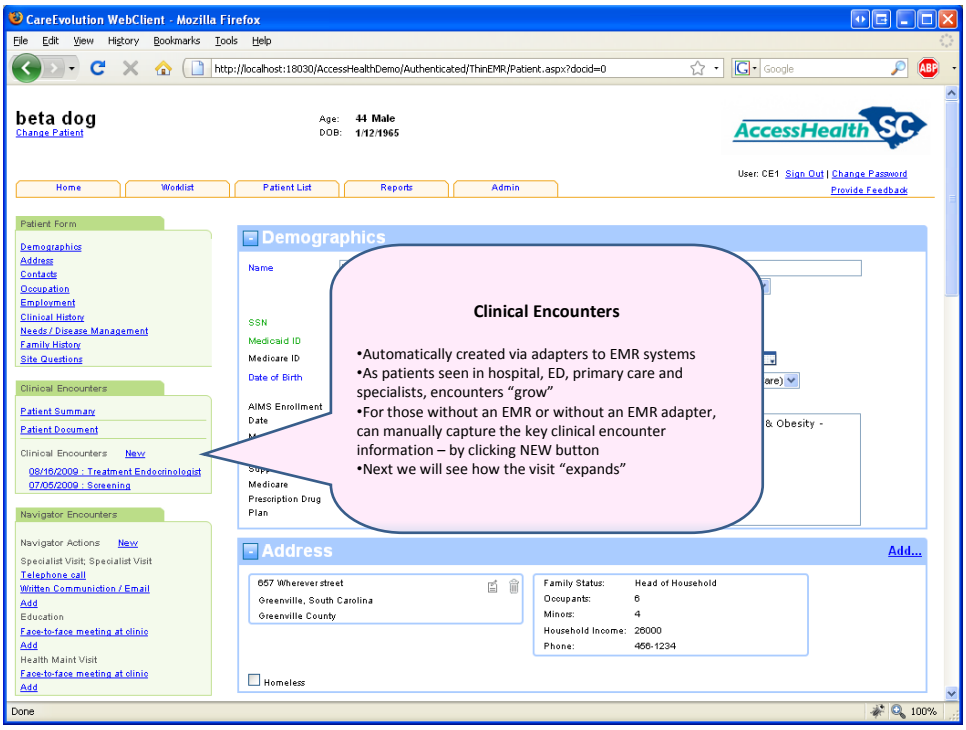

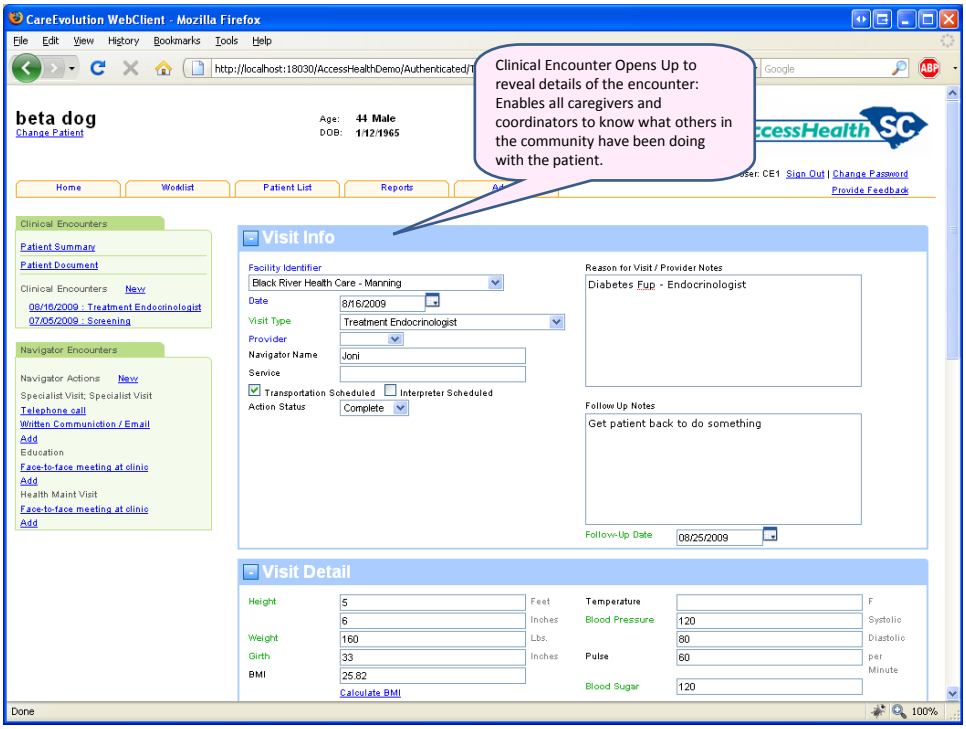

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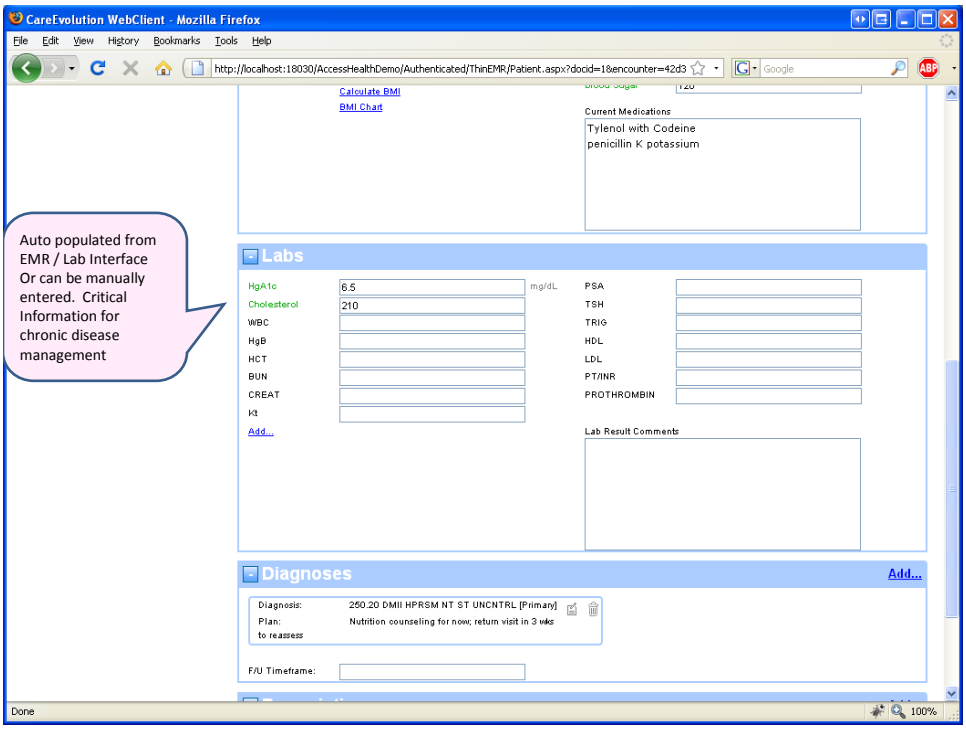

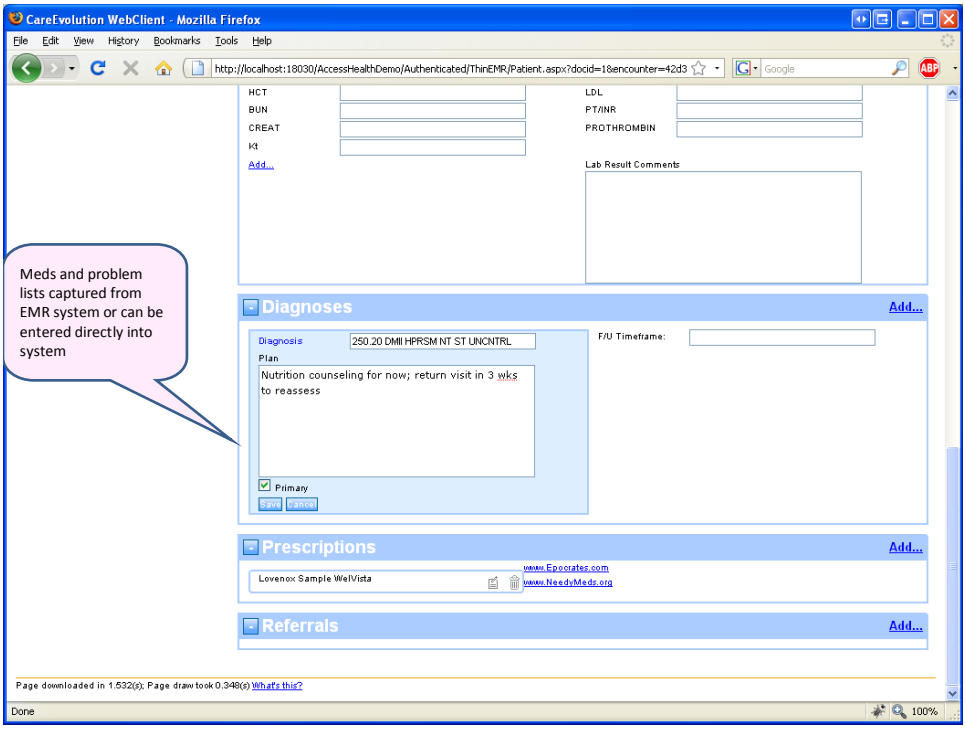

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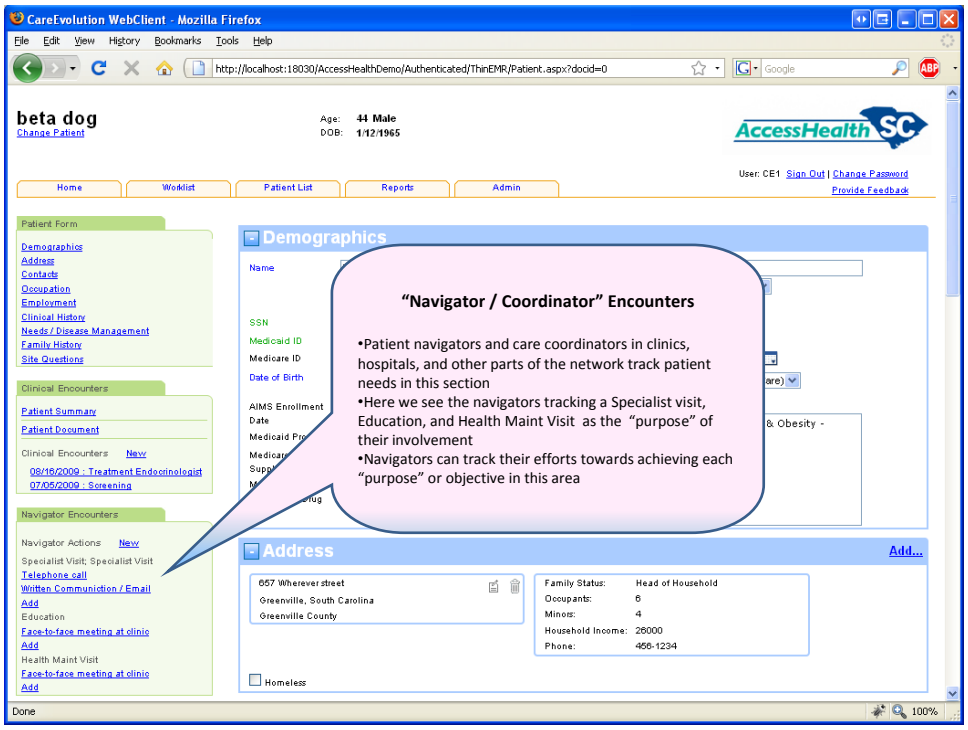

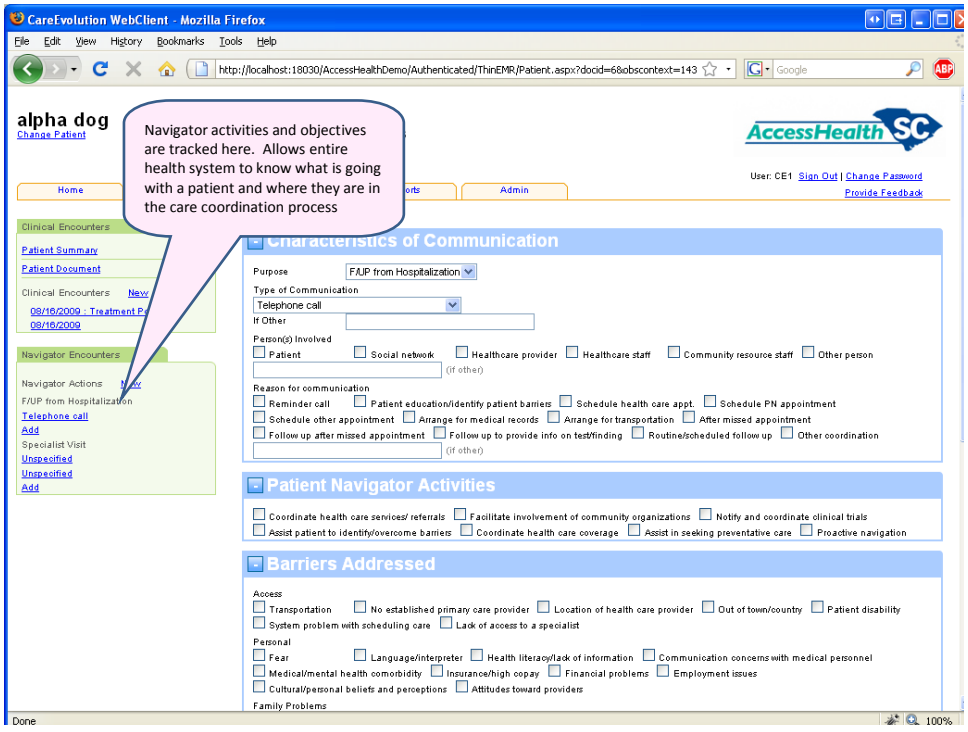

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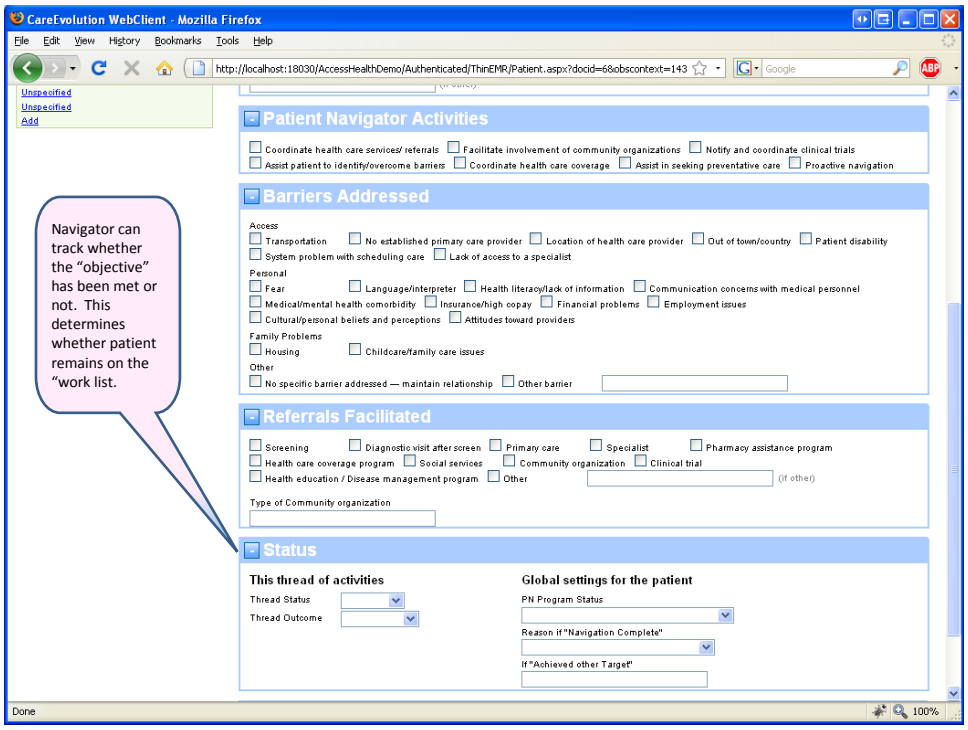

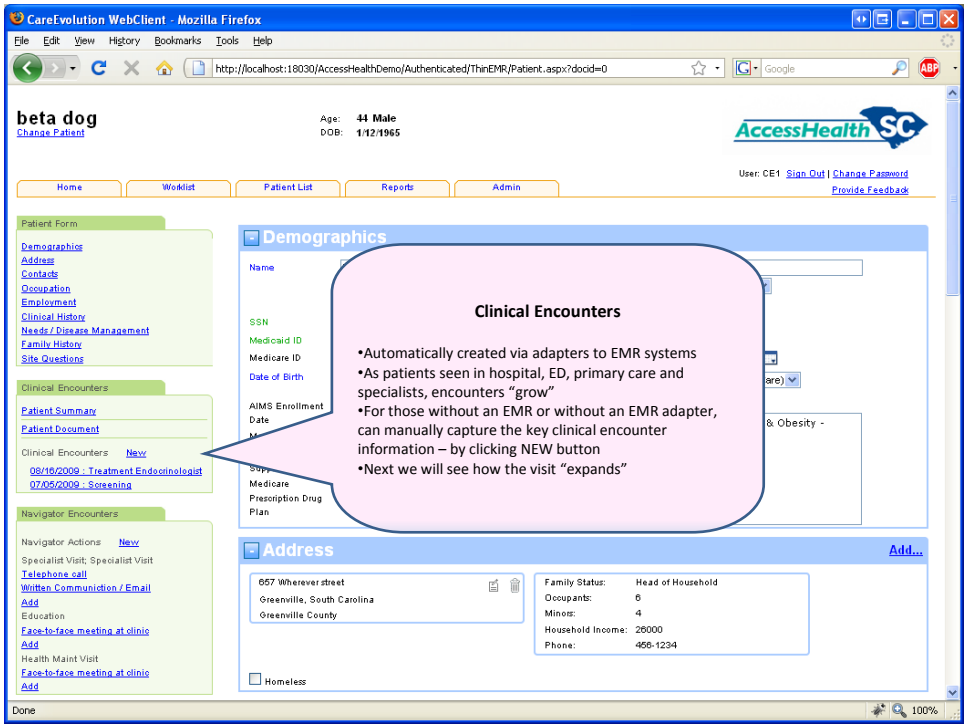

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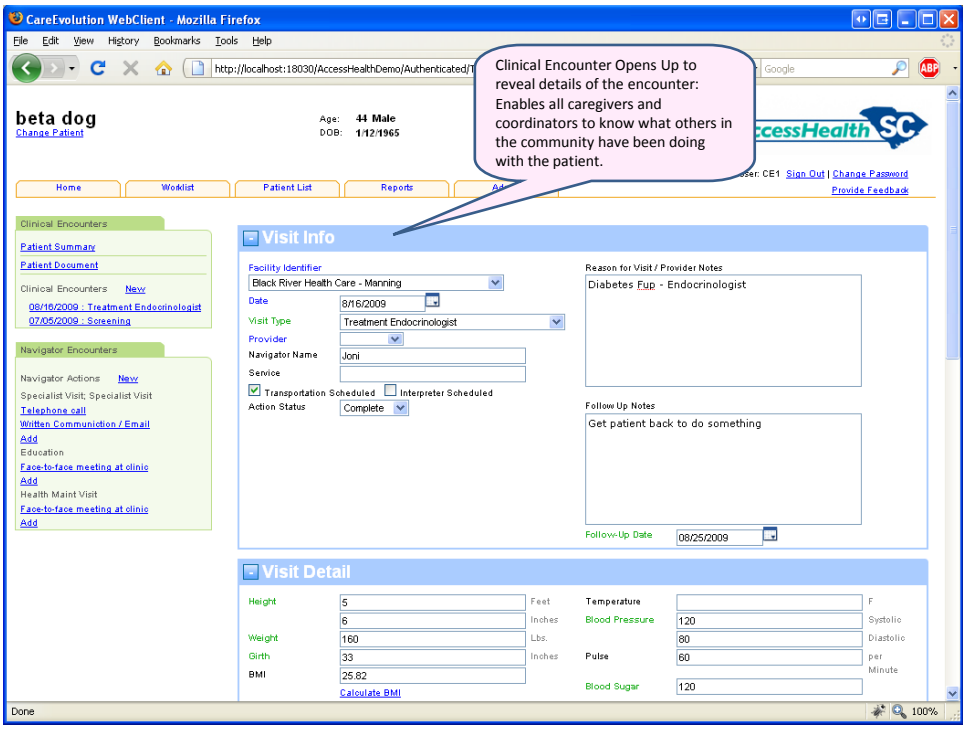

Standards-based

HIE Advantage is the only technology stack in the industry to attempt and obtain IHE (Integrating the Healthcare Enterprise) certification during the 2007/2008 IHE Connectathon/HIMSS Interoperability Showcase. Results from our IHE testing are available at the IHE Web site under CareEvolution. We recently completed the IHE 2010 Connectathon where our underlying technology platform (CareEvolution HIE Advantage™) successfully passed all 70 tests to be able to offer out of box connectivity using PIX/PDQ and XDS profiles to edge EMR systems.

IHE is a HITSP ratified standard and is now the required set of Interoperability features that EMR vendors must comply with to maintain CCHIT certification in 2009. While very few existing EMR sites have IHE compliant legacy systems, we anticipate that our continued investment in maintaining IHE compliance will serve SHARE well over the mid to long term.

We maintain the following checklist to ensure we are following the appropriate data sharing and communications procedures.

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	EXCHANGE STANDARDS CHECKLIST		
DATA EXCHANGE TYPE	**PROPOSED STANDARD**		**COMMENTS**
Demographics	Exchange Standard Vocabulary	HL7 version 2.4 or higher	2.3 or later is supported for all
Medications	Exchange Standard Vocabulary	HL7 version 2.4 or higher NCPDP (retail pharmacy) NDF-RT, RxNorm (inpatient pharmacy) AHFS, NDC, FDB	
Problem/Symptom	Exchange Standard Vocabulary	HL7 version 2.4 or higher ICD9-CM, SNOMED CT	
Major Procedures	Exchange Standard Vocabulary	HL7 version 2.4 or higher CPT-4, HCPCS, SNOMED CT	
Immunizations	Exchange Standard Vocabulary	HL7 version 2.4 or higher CPT-4, SNOMED CT	
Allergies	Exchange Standard Vocabulary	HL7 version 2.4 or higher Free text, SNOMED CT (reaction), Medications (see above), Unique Ingredient Identifier (UNII) for environment/food	

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	EXCHANGE STANDARDS CHECKLIST		
DATA EXCHANGE TYPE	**PROPOSED STANDARD**		**COMMENTS**
Hospital/ Physician Visits	Exchange Standard Vocabulary	HL7 version 2.4 or higher ICD-9-CM (physician), HL7 version 2.4 (hospital)	
Lab/Micro/Rad Reports	Exchange Standard Vocabulary	HL7 version 2.4 or higher CPT-4, LOINC (lab/micro order names), SNOMED CT (lab/micro results), DICOM (images, faxes)	2.5 is preferred. It is the new HITSP ratified standard.

Security

Thomson Reuters is the nation's largest integrator of health information warehouses and decision support systems. For over 28 years, we have been extracting, cleansing, and integrating a rich array of administrative and clinical data from across the healthcare continuum.

The HIE Advantage architecture employs a broad array of security standards, encryption technologies, and secure implementation methodologies to strongly secure data both in-flight and at-rest. As called for by HHS 74 FR 19006, HIE Advantage Suite uses the National Institutes of Standards and Technology specified standards in special publications 800-52 and 800-111 which details the specific cryptographic standards that are acceptable. In specific Federal Information Protection Standard 140-2 is called for in ensuring that data in flight is secured. Advantage HIE complies with the CIPHER technologies called for by FIPS 140-2.

HIE Advantage decomposes the NIST requirements in two broad categories:

- **Securing Data in-flight or in-motion.** Any information passed or communicated over the "network" is considered data in motion. There are two ways to secure such transmissions which may be used – message layer security and transport layer security (TLS). One may choose to encrypt the content of the message prior to sending the message. Alternatively, one could secure the actual "channel" or transport itself (such as VPN or SSL encryption within web browsers or web services). HIE Advantage **always** ensures that there is message level security so all "contents" are encrypted prior to sending "over-the-wire." In this event, even if a particular implementation fails to have a secure transport, the message is considered secure per federal standards. Additionally, the specific client deployment may

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wish to implement TLS (such as VPN or SSL) in which case double encryption would be effected. Not only would the content itself be encrypted but so would the transport. The specific encryption CIPHER used is FIPS 140-2 recommended AES (advanced encryption standard).

Note regarding "Double Encryption" – There is no federal requirement for double encryption.

HIE Advantage secure communication infrastructure is built on X.509 Public Key Infrastructure and provides:

- Identity verification of both the sending and receiving entities.
- Message encryption to ensure data confidentiality.
- Message signing verifies data origin.
- Protection against malformed or malicious messages.

In summary, HIE Advantage will use the public Internet to transmit demographic data from an Adapter (provider or source site) to the SHARE. Data security during transmission can be provided at two levels. First, HIE Advantage implements the WS-Security framework to encrypt the message body of all Web service traffic. Second, these web service calls can be transported using secure HTTP in order to meet the double encryption requirement requested for SHARE.

- **Securing Data-at-rest**. While there are physical data center safeguards and operating system and application software level safeguards to prevent unauthorized access to PHI information managed by the computing assets in the exchange, Advantage HIE goes further by encrypting critical PHI within the disk. In other words, even the database administrator does not have clear text access to sensitive PHI information such as Social Security Numbers within Advantage Suite – this is because "columns" such as SSN are encrypted. By security data at-rest, we ensure that the system is resilient against inadvertent disclosures from stolen laptops, backup tapes, and the like.

Advantage Suite goes even further in securing the record locator service or the proposed "master patient index" for SHARE. The underlying component CryptoRLS™ implements a highly advanced FIPS compliant NSA (National Security Agency) promulgated hashing standard to ensure that there is no PHI within the record locator service.

CryptoRLS™ implements an advanced, industry-leading approach to cryptographically hash all sensitive information that is stored in the centralized, statewide resource that is used for record location. The exceptionally high level of security implemented by using CryptoRLS™ on this extremely sensitive data store provides a key point of differentiation for our proposal as other commercially available solutions do not hash their record locator store.

All data that is managed within the HIE Advantage™ RLS is persisted using a secure, one-way crypto-hash format. Using this transformation and persistence scheme, the HIE Advantage™ RLS provides the ultimate level of data security. By storing data in this format, the demographic information is secure against nearly any form of unauthorized disclosure as the original clear text

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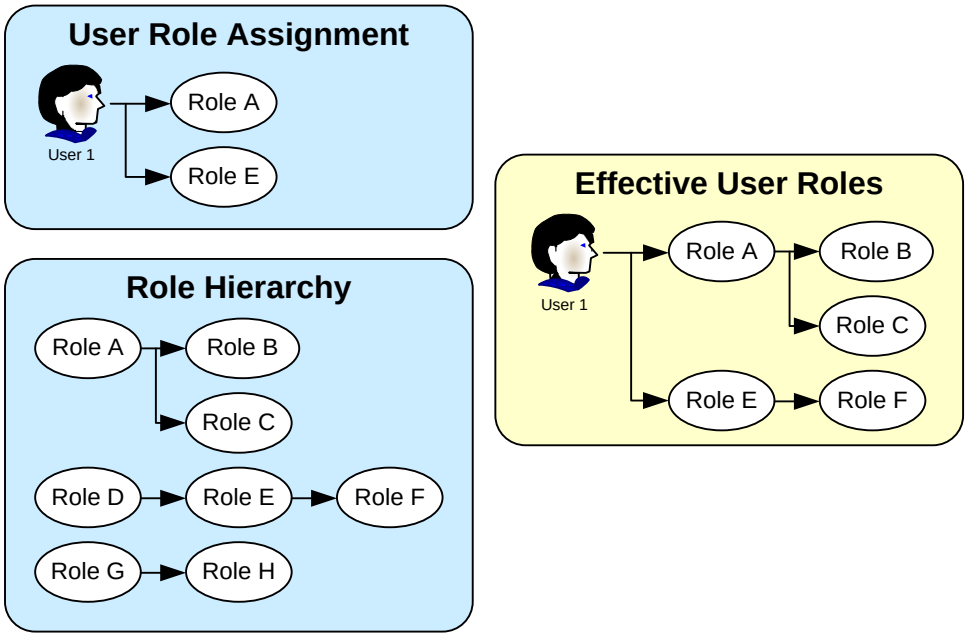
names and identifiers are unrecoverable. Record linking is performed by comparing records using the hashed identifiers. CryptoRLS™ is currently the only commercially available solution to provide this exceptional level of data protection for this critical and highly sensitive statewide resource.

Patient data that is received into a HIE Advantage Adapter via the Clinical Data Interface Service (via Secure Channel 1 as described above) can also be transmitted to other Adapters that are participating in the HIE Advantage network. This exchange of clinical data will only occur if clinical care is being provided by the facilities being served by each Adapter. This exchange of clinical data constitutes the core functionality of the HIE Advantage platform.

Privacy policies can be set on a per-patient record basis and can restrict any information from being transmitted to another Adapter. These policies can restrict records that may include sensitive information (i.e. mental health) from being sent to a specific Adapter, or to any Adapter that is participating in the HIE Advantage network.

HIE Advantage implements a Role-Based Access Control (RBAC) system that allows permission management to more closely follow an organization's structure and business activities. An administrator can create and organize roles in a hierarchical fashion representing the job functions in their organization. Users may be assigned one or more roles representing the job functions they perform.

Figure 19



When a user request is evaluated by the authorization process, it computes the roles effectively assigned to the user by traversing the role hierarchy. This effective set of roles is used with data permissions information to determine if the request is approved.

Audit Logging

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A robust and highly granular logging subsystem within HIE Advantage (described below) provides a detailed log of system authorization actions.

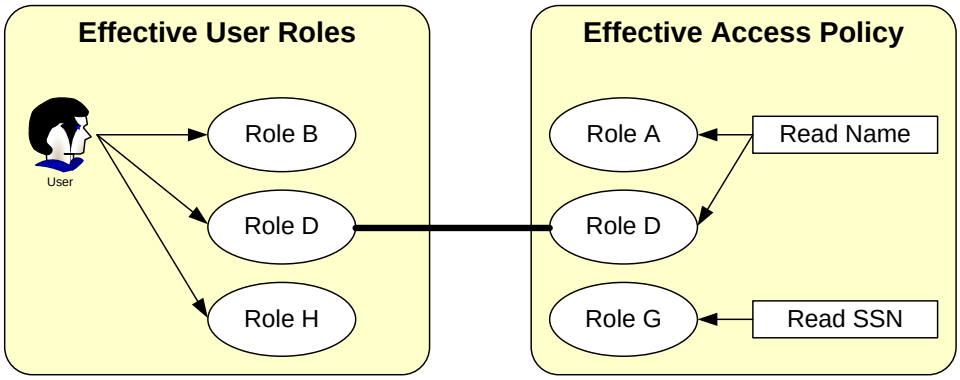
- HIE Advantage user interface components are designed to broadly support accessibility standards by implementing user design principles that ensure the appropriate use of color, animation, contrast, and symbolic information, and indications of application focus.
- HIE Advantage user interface components provide support for persons with disabilities through standard accessibility features available in commonly available web browsers. Third party software and hardware that extend commonly available web browsers to provide extended assistive features are generally supported by HIE Advantage user interface components.

Second, changing which users can access a specific piece of patient's information is significantly more straightforward in an inheritance model. If Role C should be granted the write SSN permission for all patients, the patient access policy is modified and the VIP patient policy automatically inherits the changes.

Request Authorization

When a user attempts to perform an action on a patient or an encounter, the effective roles assigned to the user are compared against those required by the effective access policy for the selected action on the requested data. If the user has been assigned a role that has been granted the permission, user is granted access.

Figure 20



In the example above, the user can read the selected patient's name but not their SSN.

Controlling access to medical information is critical to the success of any HIE effort. Organizations must be able to construct detailed security policies that protected data in accordance with organizational guidelines, and security administration costs must be minimized.

HIE Advantage provides a comprehensive access control system that protects patient information from unauthorized end-user access. System administrators can implement strong, granular security policies that meet the needs of their organization. Security administration costs are limited by a design focused toward low-over head administration and maintenance. The HIE Advantage security

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architecture addresses the challenges of access control and provides the security infrastructure to build a first class HIE.

It is important that audit information be of an appropriate granularity: detailed enough that all appropriate monitoring can occur, but broad enough that the log itself does not become a significant security or privacy risk. HIE Advantage technology platform is a comprehensive Service Oriented Architecture (SOA) with interactions with users, other systems within the data center, and with systems outside the data center.

Obsessive care has been given to the frequency and type of logged events, which differ from service to service and use case to use case. Audit logs maintain date and timestamp, user ID, workstation IP, and application type (POC user interface or data query). The following categories of audit transaction types are maintained:

- Log in / log out events (successful and failed)
- Census queries
- Patient selection
- Patient data queries
- Patient data manipulation (add, edit, remove)
- Patient index queries
- Clinical data transfer
- Administrative cockpit actions
- MPI/RLS link/unlink actions

Quality Control and Risk Management Approach

CIBER's Quality Control and Risk Management Approach ensures that best practices are being followed to meet and exceed contract requirements, task order objectives, and customer expectations.

Our process includes a structured risk management process to identify and mitigate risks throughout a project. Our process features frequent monitoring and reporting, and will include continuous feedback. Our project managers are responsible for risk management and report on status and progress. An overview of our process is shown below.

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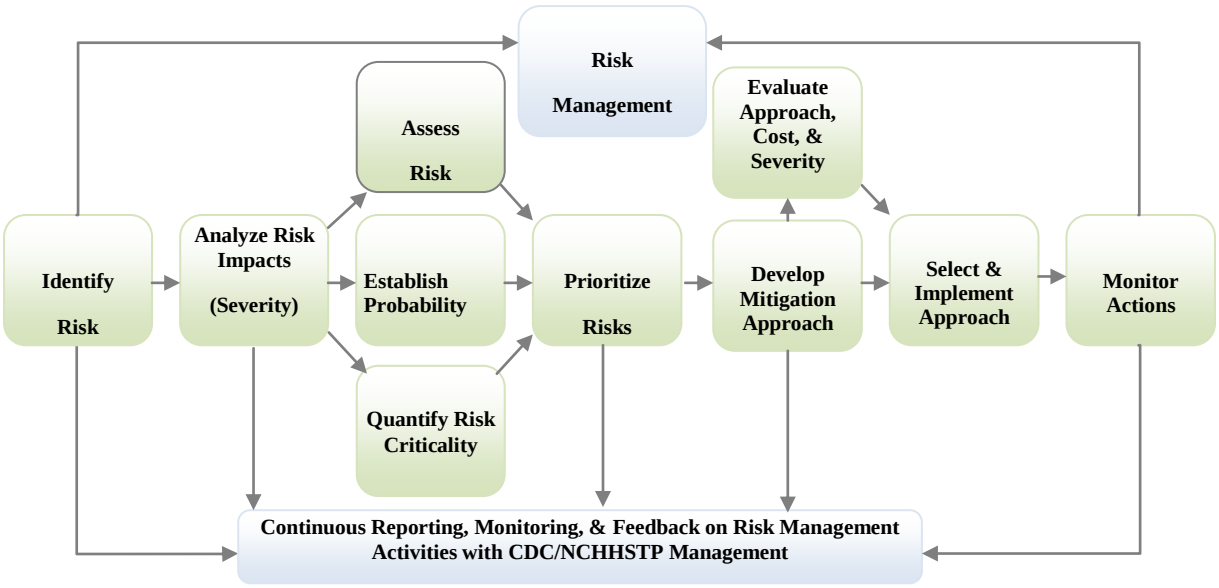

CIBER's Risk Management Process. *CIBER management and staff actively identify and manage risks to ensure our projects to consistently remain on schedule and in budget.*

Transition and Knowledge Transfer

Knowledge transfer is a critical part of our transition approach. During task phase-in, CIBER personnel begin to engage in knowledge transfer. Our personnel are able to observe the work in progress on CDC tasks and work with incumbent personnel to identify and collect project artifacts such as project plans, requirements documents, test plans, design documents, and systems plans. Incumbent capture during contract transition also facilitates knowledge transfer; keeping the personnel on staff helps to preserve project knowledge, keeps development stages moving forward without delays or interruption, and allows team members to share information about project status, such as completed milestones and stage gate reviews. CIBER's approach to knowledge transfer focuses on the lifecycle of the project: adopting the EPLC in development tasks; targeting the tasks in the development lifecycle; determining the current status of applications in progress; tracking milestones in the project schedule; preparing for stage gate reviews; and aligning milestones to CIBER's EVM. Project teams will work with incumbent personnel and CDC Technical Contacts to find out where the current tasks are in the life cycle. All artifacts collected are posted in PMRx, which makes transitioning out of the task, if necessary, a simple process.

Flexible

HIE Advantage is the only technology stack in the industry to attempt and obtain comprehensive IHE (Integrating the Healthcare Enterprise) certification during the 2007/2008 IHE Connectathon/HIMSS Interoperability Showcase. Results from our IHE testing are available at the IHE website under CareEvolution. We recently completed the IHE 2010 Connectathon where our underlying technology platform (CareEvolution HIE Advantage™) successfully

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passed all 70 tests to be able to offer out of box connectivity using PIX/PDQ and XDS profiles to edge EMR systems.

IHE is a HITSP ratified standard and is now the required set of Interoperability features that EMR vendors must comply with to maintain CCHIT certification in 2009. While very few existing EMR sites have IHE compliant legacy systems, it is anticipated that our continued investment in maintaining IHE compliance will serve SHARE well over the mid- to long-term.

We have been active participants in both the IHE and FHA CONNECT initiative and are early adopters of the CONNECT 2.2 and 2.3 SDK. From a technical perspective, the proposed system supports the recently released CONNECT 2.3 to exchange information across state boundaries or with federal agencies that are implementing the federal DURSA guidelines. This is a rapidly evolving and emerging space – few jurisdictions have implemented full federal DURSA agreements to enable them to use the official NHIN protocol. However, SHARE may choose to deploy an AR Data Use and Reciprocal Support Agreement with adjacent jurisdictions and follow the template and model provided by the NHIN. Such policy and governance work is a pre-requisite to exchanging information.

Alternatively, a particular MRR may choose to implement an IHE compliant cross affinity domain based exchange with adjacent jurisdictions that are compliant with PIX/PDQ across affinity domains. In summary, there are several technical approaches supported by Advantage HIE to exchange data with neighboring states. We would work with SHARE to determine the best options and timing for erecting the necessary policy, governance, and agreement pre-requisites prior to enabling any cross border exchange.

It should be noted that consistent with our federated approach to health information exchange architecture, HIE Advantage implements robust data transfer policies that govern the manner in which health data is exchanged between organizational entities.

Data transfer policies can be specified at two levels:

- Data transfer policies for an Adapter specify what types of clinical information that Adapter will exchange with other Adapters in the system. This level of data transfer policy serves as a default specification for how health data will be exchanged that can be overridden with a person-specific data transfer policy.
- Data transfer policies can be applied to a specific person in the exchange that will guide whether or their health data will be transmitted to other Adapters. If a person chooses to opt out of the exchange, a person-specific privacy policy will be applied that overrides the Adapter-specific default data transfer policy and does not permit data transmission to any other Adapters in the exchange.
- This flexible data transfer policy configuration can be used to implement different data transfer policies with entities in order medical service areas or states in order to comply with different standards for access or privacy.

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5.3 Other Features

Key Differentiators

For 28 years, Thomson Reuters has provided intelligent information to stakeholders across healthcare. As an independent third party, we can help you make the most of federal funding and get your state's health information exchange (HIE) up and running quickly. We have experience with numerous HIE technology systems that support disease surveillance, public health reporting, and clinical decision support. Our proven solution – Thomson Reuters HIE Advantage – provides an off-the-shelf system that makes implementation, customization, and maintenance simple.

Thomson Reuters' HIE Advantage

We take a unique approach to the exchange of health information. In addition to meeting the technology requirements outlined in the HITECH Act, we're dedicated to providing a system that's useful for stakeholders across healthcare. Thomson Reuters HIE Advantage provides the foundation for your statewide system by capturing real-time clinical and administrative data, giving clinicians a complete picture of care, and enabling advanced decision support through a centralized database.

HIE Advantage makes comprehensive patient histories — including medications, treatments, and lab results — easily accessible at the point of care. Data from medical claims, acute and ambulatory electronic medical records, and other sources are grouped into disease-based clusters using our Medical Episode Grouper technology and adjusted for disease severity using risk-adjustment methodologies. In addition, our Web-based platform includes sophisticated analytics that enable meaningful use applications and real-time reporting and alerts.

The Benefits of the HIE Advantage

HIE Advantage provides a benefit-rich solution, including:

Proven, Highly Scalable Platform

HIE Advantage provides a flexible, scalable technology platform that can serve as the backbone of any statewide initiative. The system easily expands up and out with your needs, so it's ideal for small-scale deployment and phasing. Plus, you'll make maximum use of your initial hardware investments as the system grows.

Complies With Current Standards

HIE Advantage uses a federated data model to pull patient information from different sources into a single unified view. The system has been designed with interoperability and terminology standards that comply with NHIN, HITECH, ARRA, and other standards, and can be updated easily as new standards emerge.

Meets Meaningful Use Requirements

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Because federal reimbursements are tied to meaningful use, we will build your HIE to integrate clinical and administrative data for meaningful use analytics and reporting. A Quality Measures Engine codifies integrated data sets into discrete quality, compliance, and financial measures to meet meaningful use requirements.

Flexible Data Approaches

HIE Advantage can launch through a "broad but shallow" or "narrow but deep" data approach. We typically seed your HIE with state or regional claims data (Medicaid, UB04, or other all-payer sources), covering a wide patient population with a shallow depth of information. Simultaneously, we recruit other sources with deeper clinical assets to supplement this data.

World-Class Security and Privacy

Our advanced security techniques ensure patient data is safe. We use a hybrid architecture that combines advanced functionality with a centralized data repository. This highly secure system acts as a switchboard, so it has no "back doors" that could compromise privacy. Users query the system, which then goes out to disparate sources to find the data and deliver it back. In addition, our secure Record Locator Service and Master Patient Index use a blinded directory for centralized demographic data.

Cost-Effective Implementation and Maintenance

Because HIE Advantage has been designed with a commercial off-the-shelf (COTS) architecture, the implementation costs are manageable. There's no need to invest in expensive consulting, project design, and custom development. And the COTS architecture facilitates cost-effective, ongoing maintenance as new systems and requirements are introduced.

Data Analytics and Reporting Capabilities

Supported by the world-class healthcare decision support services of Thomson Reuters, our platform links clinical and administrative data and applies data standardization that make it ready for analysis. We provide reliable measures for evaluating and demonstrating meaningful use, measuring quality outcomes, and validating cost savings. In addition, we apply evidence-based guidelines to retrospective data and reinsert the findings into point-of-care systems to support decision making.

Thomson Reuters HIE Advantage Features:	
Record Index Service	Provides the interface between the host systems and the Record Locator Service (RLS). Standardizes and blinds demographic information before sending requests to the RLS.
Data Transfer Service	Manages adapter-to-adapter communication of clinical information in pure peer-to-peer fashion.

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Clinical Data Interface Service	Hosts a set of pluggable drivers for communication with an institution's local clinical data sources, such as EMR, lab, or pharmacy systems. Allows for easy customization to support the disparate clinical data sources of each institution.
Terminology Service	Provides translation between local (legacy) and standardized nomenclatures, and is used by the Data Transfer Service and Clinical Data Interface Service.
Local Data Cache	Provides a data store in which both record location index information and clinical information is cached.
Care Coordination Platform	Supports and facilitates a wide range of daily care functions including patient inquiry, messaging, referrals, and ePrescribe.
Continuity of Care Viewer	Organizes longitudinal patient data into episodes of care and provides gaps-in-care alerts in real-time.
Centralized Decision Support Database	Allows select clinical and administrative data to be continually updated to monitor the overall performance of the network.
Personalized Health Insights Portal	Functions as either a medical home to augment patient-physician interaction or as a reference center that provides consumers with a place to view their personal health information, access data on quality and cost, and find support for personal wellness and disease management.
Advanced Applications	Includes ePrescribe and Thin EMR that allow for encounter recording and care coordination.

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